PROCEEDINGS AND PAPERS

OF THE

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California Mosquito Control Association, Inc.

AT THE

MIRAMAR HOTEL

SANTA BARBARA, CALIFORNIA

JANUARY 28-30, 1963

Proceedings Committee

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CALIFORNIA MOSQUITO CONTROL ASSOCIATION

FIRST SESSION

MONDAY, JANUARY 28, 9:00 A.M.

JOHN H. BRAWLEY, *President, presiding*

Welcome to the Thirty-first Annual Conference of the California Mosquito Control Association. I am sure all of you have had an opportunity already to see some of Santa Barbara's beautiful scenery and are enjoying the warm local hospitality. We have with us this morning three gentlemen who are going to give us the official word of welcome. First I am going to call on Dr. Joseph P. Nardo, Health Officer, Santa Barbara County Health Department. Dr. Nardo—

Dr. Nardo: Thank you, Mr. President. Members of the California Mosquito Control Association, invited guests, ladies and gentlemen, it is my pleasure to welcome you to the enchanting Montecito and wish you success in the deliberations of your 1963 Annual Conference. I notice from the theme of your program that you plan to stress public relations and the importance of public support in achieving effective mosquito control. I know this is sometimes a difficult selling job, but this has been our approach to public health for many years.

I have been in Santa Barbara County since 1946 and I know we still have far to go in realizing many of our objectives in mosquito control. We were fortunate in Carpinteria to have one of our more critical areas organized as a pest abatement district in 1937; to this we have recently added the Goleta Valley Mosquito Abatement District. Although public relations men may be able to tell you how to get necessary financial support from the taxpayer, I still feel that the taxpayer is becoming more and more resistant. Since we haven't been too successful in this regard, I am anxiously waiting to hear what the public relations men have to say.

There is one point I should like to make in the way of a recommendation. It is something I believe has to be done if California wants to stay on top. Everybody hears of California in other parts of the country. They feel that it represents outdoor living at its best. I believe that without effective mosquito and other pest control work, one cannot enjoy the environment. I should therefore like to recommend that legislative action be taken to provide for mosquito and pest abatement districts in all counties, based on a minimum appropriation of .1 of a mill against the assessed valuation. I believe this might be the most effective way to handle it. It may be difficult to sell, but we do have programs of this nature, such as the Crippled Children's program. This was largely accomplished by a corps of women many, many years ago. In this case the dramatic impact of parading deformed children before legislators brought about the desired result. I believe that California would be money ahead with control work legislated in each county. A county would not have to form a district by itself; it could consolidate with other counties for administrative purposes, but each county should appropriate .1 of a mill. For example, in a county such as this, approximately $40,000 would be made available in this way. With $40,000 I believe we could have an effective control program. I hope that some consideration can be given to this suggestion so that in your Thirty-second meeting it might be proposed in the form of a resolution.

Again, our warmest welcome and best wishes for a most successful conference. Thank you.

Pres. Brawley: Thank you, Dr. Nardo. Our next speaker is Supervisor of Environmental Health and Safety for the Santa Barbara campus of the University of California. He is also President of the Board of Trustees of the Goleta Valley Mosquito Abatement District. Mr. William K. Steinmetz—

Mr. Steinmetz: Thank you, John. Good morning ladies and gentlemen. On behalf of the Board of Trustees of Goleta Valley Mosquito Abatement District, I welcome you to the Santa Barbara area. To those of you who come from the south, that aroma you smell is fresh air. To those of you who came down from the north, we are not quite far enough south for smog. With this weather, however, I am afraid we won't have much swimming.

The Goleta Valley Mosquito Abatement District is located about 10 miles northwest of here. If any of you have any problems with little varmints during your stay, you are in Dr. Nardo's territory at the moment, so please take them to him and not to me. We are in a somewhat unique situation in the Goleta Valley. The University of California, Santa Barbara campus, is located there and we have a very active Biological Sciences Department. Many of the biologists do their experimental work around the Goleta Valley area, and we occasionally find that we have done some control work in one of their favorite creeks, upsetting some experiment. We have tried to solve this problem by hiring our personnel from the Biological Sciences Department, and we have a part-time graduate student, Thomas Cone, as our manager. Tom is here and if you need any help or want to ask any questions, he is your host and I hope you will look him up. Thank you very much.

Pres. Brawley: Thank you, Bill. Next I should like to call on Mr. F. W. Thomas, Manager of the Carpinteria Pest Abatement District, who is here to give you a word of welcome.

Mr. Thomas: President Brawley, members and guests. On behalf of the Board of Trustees of the Carpinteria District, I want to extend to you a welcome just as warm as this weather is cold. From looking at the program I know you are going to have a most rewarding experience during the next three days. Thank you.

Pres. Brawley: Thank you, Mr. Thomas. (Editor's note.—Out-of-state guests were introduced at this time by President Brawley.)

Our keynote speaker this morning is a product of U.C.L.A., he was a newspaper reporter and editor for 10 years and has been in public relations work for 15 years, 13 of those with Southern Pacific. He is a member of the U.S.C. Public Relations Council, Vice President of the Los Angeles Kiwanis Club, and is presently Public Relations Manager for the Southern Pacific Company. It is my pleasure at this time to call on Mr. Brad Atwood.

THE PRIVATE LIFE OF PUBLIC RELATIONS

H. B. Atwood, *Public Relations Manager, Southern Pacific Co., Los Angeles*

It is a pleasant surprise to see such a large turnout here this morning. In the course of my public relations duties I meet interesting people from virtually every walk of life; however, to be honest about it, I've never before met anyone in the mosquito control business. Perhaps that's because it has been so long since we've had rain in southern California. The mosquitoes just don't have any place to conduct their social activities. At any rate, when the bite was put on me to make the keynote talk this morning, I thoroughly understood the essentiality of your occupation, but I had a hunch we might gather as a cozy group around a coffee table.

I have been wondering how so many of you happened to select this particular occupation. And while I was being introduced I imagine some of you were wondering how I decided to become a public relations man. Perhaps we are both somewhat like the two bums who met on the road. One said to the other, "You know, I didn't just drift into this sort of life. I took one of those vocational guidance tests." Unfortunately, no tests are required as yet to become a public relations man—unless we consider the test of surviving in a field which is rapidly upgrading its standards and refining its techniques.

In this decade of the so-called "information explosion," research is producing such a deluge of new facts and figures that man is in a great race to try to stuff them in his electronic memory machines as fast as they are produced. And yet it is no easier than it ever was to communicate with each other. With all our new techniques for more dramatic, far faster communications, it is still hard to know when we are getting through amid a veritable cascade of words to gain attention—and more important, to be understood.

You in your special field and I as a public relations man share a common concern with effective communications. This story may help me make the point: A certain mother wished to enter her 5-year-old daughter in a kindergarten, the age requirement of which was six. To the disapproving teacher the mother explained, "She can easily pass the 6-year-old tests."

"Say some words," the skeptical teacher said to the child.

The child surveyed the teacher with dignity and, turning to her mother, asked, "Purely irrelevant words?"

I hope that what I have to say will have some meaning for you in your work, but it would be misleading for me, as a railroad public relations man or even as a general practitioner, to pose as a counselor with specific answers to your specific questions without the benefit of basic research. Instead, I suggest we take a look at public relations from my standpoint as a representative of a large industry. If you discover a few ideas which are applicable to your situation, we will have spent our time profitably.

Let us begin by trying to define public relations. Webster is only of little help; don't expect even to find the term in a pre-war dictionary. Recent editions say that (1) public relations are the "activities of a corporation, union, government or other organization in building and maintaining sound and productive relations with special publics such as customers, employees or stockholders, and with the public at large so as to adapt itself to its environment and interpret itself to society; and (2) the state of such activities or the art of organizing them."

Scott M. Cutlip and Allen H. Center, in their textbook, call public relations ". . . the planned effort to influence opinion through acceptable performance and two-way communication." Note that this definition includes a means and an end—suggesting that there must be a distinction between public relations as an existing *condition* and as a specific work *practice*.

It is possible for an organization to have good public relations and no public relations program at all. Conversely, it is possible to have a good public relations program and still have poor public relations, as in the case of the new program and policy which has yet to overcome the reputation earned by the old policy.

Perhaps the extremes of PR definitions are one writer's reference to it as the art of "arranging the truth in bouquets," and another who called it the practice of not treating the public like relations.

There is even a manual of unpublic relations, entitled "How to Cover Up Your Mistakes." In it the author, H. Harry Head, director of unpublic relations at the Peter Piper Pickle Plant in Shreveport, Louisiana, defines unpublic relations as "doing a lousy job and keeping it hushed up."

To return to the sober side, the veteran and respected PR man, John W. Hill, calls public relations "the management function which gives the same organized and careful attention to the asset of good will as is given to any other major asset of the business." And in another connection, Mr. Hill goes on to say that PR is difficult, if not impossible to define because PR cannot be isolated. "It is not a separate function. It is an integral part of management."

One more definition and, in my opinion, the best, appeared in the *Public Relations News:* "Public relations is the management function which evaluates public attitudes, identifies the policies and procedures of an individual or an organization with the public interest, and executes a program of *action* to *earn* public understanding and acceptance."

I sometimes think that the reason the term "public relations" is such a semantic trap for us today is that it simply is not old enough to be otherwise—even though a railroad man is credited with having made the first recorded use of the term in its modern sense back in 1906. (Speech by Samuel Spencer, President, Southern Railway, October 25, 1906.)

Five centuries ago people may have had the same trouble defining engineering or medicine or law. Today we have little difficulty recognizing what is meant when we consider the context and usage of these terms under varying circumstances. When we moderns use the simple term "doctor" we all understand it alike, and if we mean "witch doctor" we say "witch doctor." Some day, I hope, the term "PR man" will straighten itself out in much the same way. Perhaps we will have an entirely new name.

The same confusion is evident in any discussion of whether PR is or should be a profession. It seems to me that even we who practice public relations often overdo our talk about professional status. It has been my experience that few top-notch PR people care to make an issue of the matter.

More important is the substantial and encouraging progress in the promotion of ethical and qualified public relations practice. Many of us who practice PR or employ PR assistance subscribe to a code of standards and enforce it through a strong and growing national organization, the Public Relations Society of America. There are now 4,500 members who have met strict qualifications. I confidently look forward to the day when lack of membership on the part of any PR practitioner in this or a similar organization will imply lack of qualification for responsible PR activity.

Meanwhile, I don't think it makes any real difference whether PR is called a profession or an art or a trade, as far as the effectiveness and the essentiality of the occupation are concerned. I am sure the truly competent PR practitioner is at least a sound craftsman, and this, for now, is enough for me.

Yet, when it comes to public relations *for* Public Relations, we are like the cobbler who never took time to make shoes for his own barefoot children. We recall what the rooster said as he gazed at the plate of scrambled eggs, "You poor, mixed-up kids!"

We have a PR job to do for ourselves. Sniping at public relations is a popular pastime. There are some unethical, self-styled PR men, just as there are quacks and shysters and incompetents in other fields. But generally speaking, the debunkers themselves deserve to be debunked.

As a step in this direction, the Los Angeles Area Chapter of the Public Relations Society sent out a questionnaire to its 205 members and received 150 replies. Membership in this Chapter is typical of the national pattern: about 51% are PR executives of corporations or businesses, 17% are with institutions (e.g., hospitals, foundations, welfare funds, universities, government bodies and trade associations), 30% are owners or associates of PR counseling firms, and 2% are public relations men with advertising agencies.

From the replies to the questionnaire a profile of the typical member was obtained. He is a 47-year-old male (although there are 15 females in our chapter). He is married, with two children, and has resided in southern California 20 years. He is a college graduate and he may hold credentials in a professional field such as law, engineering, or teaching. He has been in public relations work for 10 years. It is most likely he had newspaper experience prior to working in PR. He may also have had experience in sales, business administration, personnel, education, or a variety of other backgrounds. He usually spends less than 25% of his time in publicity efforts, devoting most of his time to policy planning and administration and then to community relations and employee relations. He devotes nearly three weeks each year to health, welfare, youth, and other non-profit groups—half of his time contributed outside regular office hours. Biggest surprise to persons outside the field of public relations was the revelation that our typical PRSA member devotes so much time to policy planning and administration and so little time, personally, to publicity.

This changing role of public relations in the corporation was underscored recently in a national survey undertaken at Columbia University. Findings of the survey were summed up by one of the 253 presidents of leading corporations throughout the country who replied in his questionnaire: "As a management function, public relations cannot be totally effective without the participation of the person responsible for this effort in the formation of corporate policy." All told, 39% of the corporations responding to the survey reported that the person in charge of public relations is a member of the group which sets corporate policy.

"This represents a significant change in the role of corporate public relations over the last 15 years," according to the spokesman at Columbia University. He added, "Although the term 'public relations' has been used for over half a century, it has only been since the end of World War II that the public relations function has become an accepted tool of management."

Yes, the public relations director should be sitting in with top management—if he has earned his place there. Then he will be in a position to evaluate the organization's image and to suggest policy changes, if needed. There is no lasting way to impart a sweet aroma to a smelly situation. Sometimes it may be up to the qualified PR man to throw away the can of scented spray and reveal to management what the public really believes and to predict with reasonable reliability how the public will react to a questionable policy decision.

But a PR man should not be too hasty in advising his organization to change plans simply because they are not meeting with immediate acceptance by the public. Sometimes an uninformed or a misinformed public must be opposed and short range unpopularity must be risked in order to reach long range goals you know will ultimately be proven to be in the public interest.

These are difficult decisions, because the trap into which most of us fall (even PR men) is developing the attitude that what we say and do is right. Sometimes it is a painful experience to find how others react to this attitude. We have found this to be true in the railroad industry, and perhaps you have, also. A friend

of mine admits she has a lot of faults, but being wrong isn't one of them.

Perhaps in planning our public relations programs we should spend more time trying to understand the other person's point of view and identify our objectives more closely with his interests. We should avoid what is sometimes called the "egocentric predicament."

Not only in public relations, but in every person-to-person encounter, getting ideas across is a paramount problem—for the executive writing memos or leading a conference, for the supervisor giving orders, for the job trainer, the salesman, the advertiser, the educator, the lawyer, the reporter, even for the husband and his wife. When my wife talks I listen. When I talk my wife listens. When we both talk, the neighbors listen.

The point is that anyone who must rely on the spoken or written word to achieve results is effective only to the extent that his ideas enter, influence, and stick in the mind of the recipient or learner. This is far from being the simple process that many people suppose it to be. The average human mind resists change, resists new habits, new ideas—"the status quo is quite comfortable, thank you, so go peddle your ideas somewhere else."

The problem is often complicated by the fact that, while the idea sender understands perfectly what he is trying to get across, he is so wrapped up in, so sold on, the content of the idea that he isn't concerned with the technique of transmission. As a result he fails to put it over.

When an idea fails to enter the mind of the receiver, the responsibility for lack of success usually lies with the sender. This is the fundamental principle of idea-sending. Salesmen and advertisers accept this principle without question. So why shouldn't the supervisor, the job trainer, and the teacher accept it?

Ideas must be couched in clear, simple English if they are to get across. This problem is probably as old as civilization itself. Perhaps people speak and write in an involved way because they want to impress others with their erudition.

For example: The home economist from a university was giving a cooking demonstration to a group of farm women and said, "Take an egg and carefully perforate the basal end. Duplicate the process at the apex. Then applying the lips to one of the apertures, by forcibly exhaling the breath, discharge the shell of its contents." Eighty-five-year-old Aunt Cissie turned to a neighbor and whispered, "Beats all how different these new-fangled ways is. When I was a gal we just poked a hole in each end and blowed."

We can exchange information not only by talking and writing, but by illustrating, acting, gesturing, or by facial expressions. We can even communicate through music because by its very nature, communication is an exchange of feelings and understanding more than an exchange of ideas. We in public relations find that people who talk to each other too much and to the general public too infrequently, eventually develop a language that only they can understand.

Truly effective communication involves not only "sending" but "receiving"—not only talking and writing, but listening and looking.

Sometimes we forget that listening is the other half of talking. If people stop listening, it is useless to talk—a point not always appreciated by talkers. *Reader's Digest* recently pointed out that Americans are not good listeners. In general we talk more than we listen. Competition in our culture puts a premium on self-expression, even if the individual has nothing to express. And many of us, while ostensibly listening, are inwardly preparing a statement to stun the others when we get the floor. Yet, it really is not difficult to learn to listen. The greatest block of time in communicating is spent in listening. Research has proved that business executives, usually thought of as talkers, spend 45% of their time on the job listening to others. The key to careful listening is to work actively to discover how the speaker feels about events, what his drives appear to be, what kind of person he is. The appraisal can be only a rough one, but it can be a decided help in dealing with him and giving him a fair answer. Careful listening also helps a person to keep quiet rather than sound off foolishly. The best listeners listen alertly, expecting to learn something and to help create new ideas. We in public relations can profit by doing more listening. Perhaps you can, too.

The sum total of what we hear and see and read influences our opinions. The danger lies in failure to keep our opinions flexible as conditions change.

Correcting our faults, and telling people about our new policy, should improve our public relations. What people think about a business or an organization is important. And the word "people" includes everybody, not just those with whom the business or organization comes in regular contact. An individual is something more in public relations than just an individual. He is a member of a community, or perhaps of many different kinds of communities—church, social, professional or scholastic organizations, for example, or labor unions, or any one or more of several different groups. So the influence of the average individual may be multiplied many times over through the organizations to which he belongs. These are the kinds of people who are important to public relations. And when these people know you and know the facts, their judgments are usually sound.

It has been estimated that 127 million Americans over 12 years of age spend an average of almost 37 hours a week reading newspapers and magazines, listening to radios and watching television. In fact, more U.S. families now have television sets than have telephones.

You can no longer fool very many people very much of the time—even with an iron curtain. And so I recommend these 10 commandments of good public relations.

1. Thou shalt be forthright: He that once deceives is ever suspected.
2. Thou shalt have wisdom: A man may acquire a reputation for wisdom simply because he doesn't have enough money to make a fool of himself.
3. Thou shalt have vision: Everyone has 20/20 hindsight.

4. Thou shalt be unselfish: Take a little more than your share of the blame and a little less than your share of the credit.
5. Thou shalt have faith: Nothing is as embarrassing as watching the boss do something you told him couldn't be done.
6. Thou shalt be creative: How good a red hot idea is usually depends on how much heat it loses when someone throws cold water on it.
7. Thou shalt be modest: A good guess doesn't make you a genius any more than a hole-in-one makes you a golfer.
8. Thou shalt be realistic: The rooster crows and the hen lays the egg. Good publicity is based on good performance.
9. Thou shalt not be cynical: A cynic is a man who knows the price of everything and the value of nothing.
10. Thou shalt take the long range view: What the newspapers say tonight is not nearly as important as what people will be saying a year from now.

And who knows how we may be communicating a year from now? The world is moving so fast that the fellow who says "It can't be done" usually is interrupted by someone who is doing it. Our world is becoming smaller and smaller as the levels of transportation, education and communication rise. Television makes "instant public relations" a reality today. Yet as far as information mobility is concerned, we have just scratched the surface. There are some technical and economic problems, but no real reasons why all kinds of information could not be centrally located and available for instant display on a wall-sized television screen in our homes, offices or schools.

The first step toward a worldwide statellite communications program was taken with the placing of the Telstar in orbit. Perhaps the satellites will hasten the day of an international language.

New trends in the newspaper industry are especially evident here in southern California. By 1964, another invention, called facsimile, may make it possible to send entire editions from one city to another and directly into any building. Instant newspapers may be made possible by consumer ownership of facsimile printers, making today's news and advertising available to anyone at the press of a button. Within a few years, newspapers and magazines could be printed by a magnetic process—no inks, just colored powders adhering to rolls of paper because of magnetic impulses. Three dimensional print and television production also are anticipated.

For those interested in direct mail advertising on a "broad" scale, Dr. Lloyd Devore of Hoffman Electronics foresees computers capable of storing all the names of the world's entire population on a strip of film no larger than a postage stamp.

Dr. Devore suggests that conventional silver and paper money may not be in vogue in 25 years. Electronic charge accounts will credit your store account when you make a purchase, notify your bank to deduct the proper amount from your balance, and pay the store.

You will be able to have the latest best sellers in your libraries—stored on computer tapes. Just push a button and settle back to enjoy the book of your choice.

Dr. Simon Ramo, of Thompson Ramo Wooldridge, Inc., foresees that technology could perhaps provide more democracy than some Americans desire—for example, television push-buttons that would relay to the halls of Congress instant public reaction to speeches and maneuvers then in progress.

What about the future of public relations when these electronic dreams become realities? These physical advances are significant. But advances in human relationships may be far more important—advances that help peoples to communicate their ideas to each other in such a way that two-way tolerance, sympathy and understanding will be brought about. The means of transmitting ideas from place to place has exceeded by far the means of developing those ideas in the human mind.

It has been said that the ancient Greeks held a theory, which was violated in practice, that a town or city should not be any larger than the area that could be covered by a man's voice. Today a man's voice, and his image, travel around the world with the speed of light, but have men's minds, thinking and ideas kept pace with this technical development? Men's minds today may be more receptive to ideas that seem like new ones but are just as false as they ever were.

What is going on in the world, as Father Gannon said a dozen years ago when he was president of Fordham University, is a great struggle for men's minds. It is a battle on one side between the forces that would control men's minds through withholding information from them or giving them misinformation, and forces on the other side that would develop men's sound judgments by giving them the fullest possible information. The fight for men's minds, Father Gannon added, is the second oldest fight in the history of the human race, the oldest being the fight for men's souls. He reduced it to arbitrary power vs. human dignity and pointed out that in its modern form it is a fight between free enterprise and a planned society. One might say, it is a conflict as old as the difference between light and darkness—knowledge and ignorance —freedom and serfdom.

In a country where ideas have full play, the function of public relations is not dependent upon movements of political thinking in any direction, but upon freedom—freedom of the press, religion, voting, and above all, freedom of thought and expression of all kinds.

An Australian public relations executive called on me the other day while visiting Los Angeles on a world tour. He told me that the fundamentals of public relations are pretty much the same wherever he goes, but here in America, he found public relations has come of age.

And yet with all our refinements in communicating, there is much misinformation and misunderstanding around the world about the American way of life, as you well know.

Attorney General Robert Kennedy, speaking to the Associated Press on this subject, emphasized that all of us who understand America, who believe in our economic system and who are reasonably articulate, have an obligation to convince the people of foreign countries, and particularly the students, that we are true to our ideals and that prosperity and health can be achieved in a system which preserves individual liberty.

Capitalism has become a dirty word, said Mr. Kennedy, because it is synonymous with selfishness. Many people in foreign lands believe that Americans are interested only in material gains—that they are not interested in their neighbors, not interested in their communities, and not interested in those who are less well off. Unless we can offset this impression, first by our actions and then by communicating, people-to-people, we will lose the cold war, said Mr. Kennedy, no matter how much we spend on foreign aid.

And so in conclusion, I suggest, while you are considering "maximizing communications" at this conference in order to gain better understanding and acceptance of your association and its goals, that you consider also your individual responsibility in the practice of good public relations and the building of international understanding and good will toward America. To approach this goal, we must not only speak and write clearly and knowledgeably, but we must listen and interpret. If we can do these things well, we will be practicing public relations at the highest level. More important, we will be upholding our American heritage, because in the space age, more than ever before, effective communication is the key to universal understanding.

Pres. Brawley: Thank you, Mr. Atwood. I am sure that all of us who are obliged to work closely with the public are in agreement that communications and public relations are considerations of the highest priority, and you have given us a great many things to reflect upon that will be helpful to us in the future.

For the next portion of our program, which deals with public information, we have three speakers. The first gentleman who will be speaking to us is a member of the bar of the Supreme Court of the United States, American Bar Association, American Judiciary, and at present is Vice President—University Relations at the University of California, Berkeley. Mr. Earl C. Bolton—

COMMUNICATION AS AN ASPECT OF EDUCATION

EARL C. BOLTON
Vice-President—University Relations
University of California, Berkeley

Perhaps I should confess at the outset that my last contribution to mosquito abatement was not altogether successful and I think one of the reasons I accepted this invitation was for the opportunity to strike back after these many years. Let me tell you about it.

After 21 days on a troop transport bound for Hollandia, New Guinea, we, a small group of allied officers, arrived at our destination and were escorted to the transient officers' quarters. This sounded very lavish but turned out to be a floor with a tent top and nothing in between. Although we had received a great deal of instruction about atabrine and were a little yellow from the exposure, we had not yet encountered a real South Pacific mosquito; hence we had a briefing after dinner on how we were to retire that evening. After seeing a movie we went to our quarters and there found cots, frames and mosquito netting. The procedure for retiring was to get into bed, tuck in the netting all around, and spray inside the netting with the aerosol bomb. We were then to put this bomb on our feet for the night—which in itself was some kind of master victory for the mosquito—and proceed to sleep. Well, next morning I discovered that either because the bomb hadn't been used properly, or because the proboscis of the mosquito was smaller than the mesh of the netting, there was a great row of mosquito welts on my arm. I vowed then and there that some day I would get even with mosquitoes, and this is the first chance I have had since that time. It is a genuine pleasure to be here with you and I assure you my revenge will be focused exclusively on mosquitoes.

With Brad Atwood here from the Southern Pacific, with the conference being held at Santa Barbara, and with communication being the subject of this morning's discussion, I must tell you one of my favorite stories— and some of you may have had this experience last night if you were a pasesnger on the Lark.

The Southern Pacific runs a first-rate train, as you all know, called Train #76, the Lark, which comes down the coast at night, passes through here about 5:30 a.m., and on to Los Angeles. This story is about the very verbose and garrulous fellow who, before boarding the Lark in San Francisco, stood on the platform and in a loud voice so that other passengers in his car could hear him, said to the porter, "Young man, here is a $10 bill. I have a multi-million dollar transaction in Santa Barbara tomorrow morning. I must disembark there and I am a very heavy sleeper. I might put up a fight but put me off anyway. This $10 bill is to insure that you get me off the train at the Santa Barbara station." The porter said, "Yes, sir," put the $10 bill in his pocket, tipped his hat, and the man went to his berth and retired for the night. The train rumbled down the coast through the night and the next thing the man knew was a little vibration as the car stopped. He threw up the blind and, to his horror, he was looking out on the platform of Union Station, Los Angeles. He jumped up, dressed as best he could, and leaped from the train. As he ran to catch a taxi to go to the airport to get an airplane back to Santa Barbara, he paused in front of the conductor and the porter just long enough to say a few things about their ancestry, how they operated their railroad, and so on, and then ran on to catch his taxi. After he had gone out of earshot, the conductor removed his hat, mopped his brow, turned to the porter and said, "You know, I have been a railroad man with the S.P. for 35 years and that was the maddest passenger I ever saw." The porter said, "Yes, with one exception—you should have seen the fellow I put off in Santa Barbara this morning." The problem of communication!

I think for my contribution here this morning I shall attempt to build upon Brad Atwood's outstanding keynote talk. First I would like to spend a few minutes setting a framework on the philosophy of communication, second to discuss briefly some of the inhibiting factors which all of us face as we try to communicate today, and third, with your permission, I should like to suggest some specific things which you might want to consider in your individual programs.

Probably the most difficult thing that a man has to do in life is to think. This great talent which sets us apart from other living things is coming to be used rather infrequently. When was the last time that you were able to sit in a chair for 30 minutes and think about some single subject? Thinking is an extremely difficult process. One reason why the school teachers urge our youngsters to read books is that this is one of the ways they can have a conversation with a good mind, alone and in a state of tranquility, and derive the benefits that are available from that process. When I say that thinking is a difficult thing to do, I mean that as a school teacher and a lawyer, and as a public relations person and a communicator I find it extremely difficult to transmit ideas into the mind of another human being. The process of getting you to see what I see or think what I think is beset with many obstacles which tend to inhibit successful communication. Naturally, this is important to me as an educator.

What does a university do to help stimulate the techniques of communication? In preparation for these remarks I asked that our bulletins be surveyed, and I discovered that more than 2,000 courses at the University are related in some way to the problems of human communication—semantics, linguistics, speech, dramatic arts, journalism, decorative arts, and music. Men communicate through their emotions as well as through languages. Every language available to man you will find taught or covered in the library of the University of California. Our Education Department has many courses in visual media instruction; this is becoming enormously important. Theater arts, photography, and cybernetics—this new science of men talking to machines and machines talking to men—this wasn't even in the curriculum, gentlemen, when any of you in this room went to school, but it is now a great new art of vast importance.

With this background of what communication means to education, I would like to begin the second block of material on the factors inhibiting communication by suggesting another definition of public relations. Those that Brad Atwood gave us are enormously helpful, it seems to me, and one that I have also found helpful is that which appeared in *Fortune* magazine a number of years ago: "Public relations consists of excellent performance publicly appreciated." Without either element there is no real public relations program. Thus, the essence of communication is based in the first instance, in your work as well as mine, on excellent performance.

In considering these inhibiting factors that tend to break down the second part—public appreciation—I am going to assume that we are doing the best we can to achieve excellent performance. One of the inhibiting factors is concerned with the communications revolution in which we are living. Many men in this room did not grow up in homes in which there were radios. Probably your first radio was a crystal set with a "cat whisker." Now think, in our lifetime, of the step between the "cat whisker" and the color television set. Did you know that recently we put a light beam on the moon and it reached the moon and back in two seconds? Oh, we sent a radar signal many years ago to the moon and back. These transmissions of lasers, as they are called, which weren't even known five years ago, can now theoretically carry every conversation on every telephone circuit in the world on a crystal the size of a baseball. Telestar is overhead to perform its miracles. As I said, cybernetics is here. This revolution of communication techniques is so great that it is extremely difficult for us, as participants in this revolution to understand its full meaning. So, one of the inhibiting factors we have to deal with is this enormous breakthrough of communication techniques.

Another inhibiting factor is this competition for attention. What kind of a mosquito have you that is so alluring that it can capture the attention when somebody is thinking about Sophia Loren? Perhaps we will have to import from the waters of the Nile a special kind of mosquito to capture the attention of our editors when they have their attention riveted on the latter day Cleopatra, Liz Taylor. All of the demands for your attention are so sophisticated and so startling that it is extremely difficult for you or for me to try to develop a continuing communications program which can compete. The inhibiting factor I am discussing relates to psychological diversion. Think of the actual noise diversion in our society. Did you know that there is evidence suggesting that man's ear is gradually becoming duller and duller? Your eye, as you know, has a device so that when it is faced with too much light it closes, and as a result is not impaired. Your ear has no such protective device and there is good evidence that man in the past heard better than we do because our ears and nervous systems simply are becoming conditioned to the noise in modern society—the jets, the traffic, the ringing of the telephone, the increase in volume during the television commercials, and all of the other things which beat upon us. Our ear is simply saying, "I no longer need to hear as I used to hear when man walked the forest." And so these are the competitive factors which detract from the kinds of programs you and I are here to talk about.

Another inhibiting factor that you and I must face is the simple matter of numbers. Five hundred thousand new Californians come here every year—net! They haven't paid any taxes, they are not much interested in mosquitoes, nor in the University of California, nor the other institutions of this state. They will be in time but you and I must help to bring about this awareness. A great new market of people needs to be informed about your work and ours, and the work of the Southern Pacific, and the newspapers of the state and the oil companies, because these people are absolutely new to us. They do not have the traditions of our state; they have not supported it; they do not have an investment in you nor in me, and it is a frightening problem to contemplate how we are going to instruct this group.

You deal with a very difficult subject. I thought it would serve to illustrate this point of complexity if I were to go through the Proceedings of your 29th An-

nual Conference, which Mr. Peters so kindly made available to me, and pick out a list of the complex names that you are going to have to relay to the laymen. Well, I started on this and had a pretty good list in front of me when I discovered both that I couldn't pronounce these names and that it would take too long to cover the list. So, I simply make the point that you are having to communicate in your work some extremely difficult kinds of materials. That in itself is an inhibition on communication.

Finally you are faced with what I call Bolton's Law, with due apologies to Mr. Parkinson. Mr. Parkinson pointed out, you recall, that expenditure always increases to meet revenues and that somehow the staff always manages to meet the same amount of work with increased numbers and increased budgets. My law is a corollary and it says that the better you do your work, the worse off you very well may be because budget tends to follow problems. The better your agencies are administered, the fewer the problems, and the less need for increased budget. If you get rid of mosquitoes, it seems to me that some are likely to ask, "Why should we be paying for this expensive work when obviously there are so few mosquitoes about anyway?" The most efficient public service is very likely to have the least known about it because it operates in a tranquil way, achieving the work it is supposed to do.

Now I come to some specific suggestions that I would like to make, and the first relates to what I have just described as Bolton's Law.

First, as you tell the story of how to control mosquitoes, I urge you to tell why you continue to be concerned with mosquitoes. You face a problem similar to the one which the public relations people for the National Foundation faced. It is alleged that the problem of polio is solved. In the minds of many people this is a fact. Therefore, why should I support an effort to get people to fight polio? As you meet the problem of the mosquito you must also continuously devote part of your effort to why you are continuing to meet the problem and how this must be a matter of continuing grave concern to us all.

Second, you must somehow create a sense of urgency. I take it from what little research I have been able to do in your field that at one time the sense of urgency was primarily a matter of public health. Malaria was the threat and it was necessary to stamp out mosquitoes because of malaria. I also take it that this aspect of the problem, at least relatively, seems to have diminished and now it is very important that you create a new sense of urgency. It seems to me that this can come from the economic and recreational areas of our life. It seems clear that you can demonstrate that if a mosquito is present the farmer or industrialist is not doing his best to protect his own economic status because he is putting water on the land and using water in a way that is to his economic detriment. If you can push this gentleman's nerve in the area of his pocketbook you are going to find it is almost as successful as when you push it in the area of his health. Also, as California grows it is obvious that its recreational capacity must be protected. Here again, it seems to me, you can create and maintain the sense of urgency which is so necessary if man is to respond. It seems to me further that you must convince all of us that this is an "all-hands" effort; that the industrialist and the agriculturalist must work together; but additionally, that the individual land owner with his acre, half acre, or backyard has to concern himself with the problem.

And now, I will close with a little aphorism my grandmother was fond of. She was a delightful lady, a very religious lady, but a kind of religion which was warm and humorous. She used to say, "If Noah had been really wise he would have swatted those two flies." I submit to you, if we substituted "mosquito," we wouldn't be here this morning talking about this subject. But Noah didn't swat the two mosquitoes either. They somehow got through and they are very much with us, and your responsibility, of course, is not only to swat the mosquitoes but also to let all of us know how we can help you in this.

The University of California is proud of what it does in relation to your work, and is honored to be a part of your efforts at this Conference.

THE PRESS AND ITS RESPONSIBILITIES

PAUL VEBLEN, *Executive Editor*
Santa Barbara News Press

I was very interested in hearing Mr. Bolton's comments about the broader aspects of communications and public relations. As Mr. Brawley indicated, I will speak on a rather narrow area of public relations and public information—the area concerning the newspaper, with a few side remarks about radio and television.

First I think we should talk about what your interests are, what the interests of the newspaper are, and what the interests of the public are. Very happily they coincide in most respects. Your interest, of course, is to get your story across to the public, to inform local citizens about what you are doing so that you will have public support. Certainly without such public support your accomplishments will be rather limited. The newspaper's interest is to help you get your story across, as it is to get the story of other segments of society across to the public. But we are interested primarily in news—N.E.W.S. "News" comes from "north," "east," "west," and "south," which indicates the broad interest that the news has. We are the funnel for news from all segments of our readership area and from the country, and from the world. In other words, there is great competition for these valuable inches of news space in the paper. For this reason it is important that each segment of the population that has news, or a story it wants to get across to the public, be able to make it interesting. It is important to know the techniques for getting the public interest and for getting the interest of editors of newspapers and managers of radio and television stations so that they will cooperate in getting the story across to the public. The public's interest in all of this, of course, is to be informed. It is extremely important in a democracy that the public be informed, that it know the background and details of each program so that it will be in a position to make

an intelligent decision on each of the important problems that it must collectively face. I think that your interests can be served first in a very specific way by making contact with the newspaper editor in your home community. I know that when something is brought to my direct attention and I am filled in completely on the background of a specific program, I develop interest in that program and become more interested in seeing that it is well covered. Newspapers are produced by people, and if they are to serve your particular purpose they have to be interested in what you and others like you are doing. After this liaison has been established between a news agency and an organization such as yours, it is important that you bring to the newspaper's attention any specific news that breaks. Of course, we have in this state something called the Brown Act. Under this act it is compulsory that public agencies notify the newspapers when there is going to be a meeting on any matter that does not deal with private personnel problems; however, I think it is important to go beyond the law. It is important that when a meeting has been held and it has been impossible for the newspaper to cover that meeting that somebody be designated to tell the newspaper what went on.

With this great proliferation of people or population that Mr. Bolton was talking about, and the great proliferation of public agencies and governmental units of all sorts, it becomes impossible to have a reporter at every meeting within a paper's readership area. In our case we probably have as large a staff as any newspaper of our size in California, perhaps in the country, and we find it impossible to have a reporter present at every meeting of every agency in our area. I believe you should think not only in terms of specific news, what happened at this meeting, for example, but from the standpoint of broad public understanding. Try to think in imaginative terms about what you can tell the people about your work, the background and importance of it, and new methods and techniques. Even things that don't happen in your area can be given a local slant and made of interest to the people in your area.

I must admit that I have not been particularly intimidated by California mosquitoes. I was brought up in Minnesota and we were very proud back there of the size and ferociousness of our mosquitoes. You have probably read the Paul Bunyan stories and remember how they used to take care of the mosquitoes up in northern Minnesota. The mosquitoes were in the habit of drilling through the roofs of the barracks of the lumber camps, so they would grab a big hammer and bend over the proboscis. It worked very well except that after 8 or 9 had drilled through and been hammered down, they flew away with the roof. But I have gained from my reading on mosquitoes that size and aggressiveness do nt necessarily indicate the damage a mosquito can do.

It was interesting, just before coming over here, to look through the clips we have in our files. These apparently only extend back to 1944, and I found about 150 clippings of stories, pictures, and editorials about mosquitoes and mosquito problems in our area. I was disappointed in the range of these stories. Most of them were rather prosaic; some were quite interesting. I would like to bring these to your attention primarily to show you the type of coverage that one newspaper has given to the mosquito problem, as well as to areas of coverage which have, I think, been neglected.

Here is an illustrated story from 1947 headlined "Aerial Attack on Mosquitoes Made at Goleta." It says, "Young Bill Stearns flew 'operation *Aedes*' at dawn today in an attempt to reduce the mosquito population in the Goleta area. In a super-powered Stearman PT-17 the youthful pilot swooped down over approximately 200 acres of salt marshes. . ." This activity was not sponsored by any governmental agency. It was an operation cooperatively financed by five public and public spirited agencies and organizations—the T. B. Bishop Company, the Devereau Foundation, the Goleta Lemon Association, the Airport Commission of the City of Santa Barbara, and the War Assets Administration. This was before the days when we developed two fine mosquito abatement agencies in our area.

Then I came to the story (we seem to have at least one of these every year when the mosquito season comes around) which says, "Are you raising mosquitoes? The Santa Barbara County Health Department has received widespread complaints on mosquitoes during the past week." Then Dr. Nardo, whom you heard this morning, goes on to tell local residents what they should do about it. This is more in the area of governmental activities than in the area of what individuals should do; however, I think bringing things of this nature to the public's attention may be an important step towards the establishment or expansion of mosquito abatement districts.

And then the Board of Supervisors comes into the picture, turning down the proposal that a south coast mosquito abatement district be established. "The County Supervisors yesterday afternoon recommended to the Goleta Valley Mosquito Abatement District and the Carpinteria Pest Abatement District that they consider expanding their districts." We have had a little trouble in this area getting a south coast district established—one that would extend all the way from the Ventura County line up to Gaviota Pass on the north. I think it will come, but only if there is continued attention to the problem. Perhaps it would come more quickly if we had one or two very bad mosquito years. It is unfortunate in a way that the mosquito season seems to be so short. We hear a terrific hullaballoo about the problem for a few weeks and then the mosquitoes seem to vanish. From the standpoint of the fellow who does the swatting the need for a program seems to vanish too; he doesn't think about it again until next year and in the meantime little progress has been made towards providing a solution.

Now we come to the City Council of Santa Barbara. "City Councilmen met and decided yesterday that Santa Barabara's mosquitoes aren't bad enough to take part in the south coast's $50,000 a year program to eliminate them."

These are all specific stories about activities of governmental or private nature. Another dimension of coverage, and one which you can help stimulate if you bring it to the attention of your papers, is the aspect of editorials. One way to help develop public interest, of course, is to have comment on the problem; not

only a specific news story telling what is happening but also comment about it. If you bring your problem to the attention of your editor, there is a good possibility that he will be inclined to write an editorial of this nature.

This editorial comes from way back in 1944. It says, "From time to time, with state and federal assistance, and over a period of many years, the Santa Barbara County Health Department has engaged in some mosquito control activities. Much of this activity has been in the Carpenteria district. None of the mosquito control program has been considered a major public health activity. Now mosquito control and extermination promise to become very much a mojor public health activity throughout the United States and particularly in the areas that enjoy a climate as mild as that of Santa Barbara. It behooves Santa Barbara County to review its mosquito control activity of the past and be prepared for the development of programs that will emphasize extermination rather than control." So, in 1944 thought was being given to what should be done after the war to help curb the mosquito problem.

Here is another editorial from 1958. "Newspapers have the habit of taking bold, firm positions on unimportant matters to avoid a controversy. For some of them the No. 1 tenet seems to be 'don't make anybody mad.' It isn't because of such a philosophy that the *News Press* hereby declares war on the mosquito. True, it is a mighty safe position to take, but the plain fact of the matter is, we just don't like mosquitoes." And then the editorial goes on to suggest expansion of mosquito abatement districts to cover this entire south coast area. It winds up by saying, "If there are any objections to this editorial, they probably will come from a mosquito." I did not hear any objections but I haven't seen any broad district being formed either.

Then the University came out with an editorial. It says, "Too little and too late seems to be the explanation for the inadequacy of the mosquito abatement program to protect students of the University of California and residents of Isla Vista and Goleta areas from a plague of mosquitoes in recent weeks."

A column by Tom Cleveland adds a dimension which some of you might find useful. He started his Sunday column like this: "The people in Santa Barbara County, or Santa Barbara, haven't got brains enough to know when they are bit by a mosquito, said a member of the Board of Supervisors facetiously last week in complaining about a lack of cooperation in forming a mosquito control tax district. He may be somewhat correct. We in this mosquito-free paradise—that's only partly true—may have forgotten what is is like to be stung by a member of the . . . *Culiseta.* Santa Barbarans should relearn this old skill. They travel a lot. It can be embarrassing to swear off eating strawberries while on a trip only to be told their "hives" are actually mosquito bites. This is a field which schools have generally overlooked. There is not one single course available from kindergarten through university on how to tell when you are being bitten by a mosquito, although we were advised that special arrangement could be made for those working on Ph.D. dissertations. So the following may suffice for the moment. The first thing you are apt to notice about mosquitoes is their sweet song at eventide. This comes from the mama mosquito letting the male know that she's out on the town. The male is decked out with plume-like antennae, on the order of TV rabbit ears we gather, so he can find his amorous mate in the dark. Also, as you may recall, the male is not equipped to bite. The gentle soul is content to feed on delicious nectar and plant juices. The female, who can also get along on this diet, is an ambitious sort—always looking for something richer. After her musical rendition the female mosquito comes in for a landing on the human victim, generally so gently that it cannot be detected. She selects a spot and literally saws her way through the skin . . ." Well, you know the rest.

The thing that is perhaps most lacking in the coverage we have had is background information—specifically what are the local districts doing? This is an area that I am going to look into personally to see that we do get better coverage. We have not given to our readers enough specific information on what the mosquito abatement districts we do have in the area are doing. As I said, I don't know why I should worry about it; I am not intimidated by these California mosquitoes, at least the ones we see around here. However, while they are not as big and ferocious as the Minnesota varieties, they are an unpleasant and uncomfortable menace and I use the word "menace" very literally. It is certainly in the interest of all of us to keep them from taking over. I think that if you take it upon yourself to cultivate the newspaper, radio, and TV men in your area they can be of great help to you in the important job of educating the public. Of course, as in all other aspects of our domestic society, an informed public is the best assurance for continued progress. Thank you very much.

Pres. Brawley: Thank you, Mr. Veblen, for the very timely hints on how to get our story across in the newspapers. To give us still further information on this matter of communications, we have a gentleman who again has a very interesting background in public relations work. Also, he is another very fine gentleman to know, and I have a notion that some of you may look him up before the Conference is over. He is Chairman of the Board of the Santa Barbara National Bank. He has served as President of the Santa Barbara Chamber of Commerce, local President and Regional Governor of Rotary, President of the Music Academy of the West and, of course, has many other affiliations. He has been with Associated Oil since 1922, and came to Santa Barbara in 1947 as Vice President of their subsidiary, Seaside Oil Company. Since 1954 he has been President of Seaside here in Santa Barbara. I believe he is planning to retire in a few days—on January 31, to be exact. Mr. R. J. Irvin—

PARTICIPATION IS THE KEYNOTE

R. J. Irvin
President, Seaside Oil Company, Santa Barbara

Mr. Bolton's discussion of communications impressed me very much, and it reminded me of how difficult it is sometimes to communicate even the most simple

things. It reminded me of the minister who was walking down the street and met a friend he hadn't seen for some time. They passed the time of day and the friend finally inquired as to the health of the minister's wife. "Oh, you haven't heard?" the minister said. "My wife passed away and went to Heaven." Immediately the friend said, "Oh, I'm sorry." Then he realized that didn't quite fit the occasion so he said, "I'm glad." Then he became confused and said, "I'm surprised."

I, too, was interested in learning something of the behavior of mosquitoes and I went to the encyclopedia to find out a bit more about them. My encyclopedia is 1938 vintage so I am sure something has happened since then, but I found out that instead of there being just one simple little fly or gnat, there were at that time 1500 species of mosquitoes. I assume that in the intervening 25 years quite a few more have been identified. I found out also, as Paul Veblen did, that it is the female that does all the damage. She is the one that does all the prowling and is the one that does the bloodsucking, which is quite different, of course, from man because I have found in my experience that it is the women who make suckers out of the men.

Considering this matter of communications, one more little story occurs to me that seems to apply. A fellow went into an exclusive tailor shop in New York to order a suit of clothes. The tailor said, "Oh, we don't make clothes; we create here. As a matter of fact, we take a look at you, we have you psychoanalyzed, we study the color of your hair and the tone of your skin, and we finally decide just what kind of a suit you should have. Then we send to Australia where they grow the finest wool in the world and we get the very best wool that will fit all of your characteristics. We have that wool shipped to Scotland where it is woven by some of the most famous weavers in this world. When the material is finally sent to us we cut out the suit, then try it on and try it on until it fits you perfectly. You can then walk down the street feeling like a king. The man said, "Yes, but I am going to be married tomorrow and I have to have that suit tomorrow afternoon." The tailor said, "Well, what can you do? We will have it ready for you."

I wondered why I was invited to speak here today and I concluded that you had a time spot open, and that you wanted someone locally in addition to Paul Veblen and then besides that I had some pull. Someone on the Program Committee has a secretary who is my sister-in-law.

I have decided to tell you about a program that is in progress now in Santa Barbara by way of illustrating the subject of my talk—participation. I believe that the mechanics of this program will be interesting to those of you who may be called upon in your own communities to develop enterprises or community activities. Also, as a past president of the Chamber of Commerce it will give me an opportunity to tell you a little bit about Santa Barbara.

All of you know, I am sure that Santa Barbara is a place where many retired people come and it is also a conference and tourist center. In the old days it used to be a place where wealthy people came for the winter and then decided to establish homes; as a result, we have a number of these large estates. Two of the estates, the Clark estate and the Child estate, were adjoining, and in 1928 the Clark estate was given to the City of Santa Barbara. It is now our bird refuge—a very beautiful spot. The Child estate adjacent to it in the main was on a hill some 250 feet above sea level. It looked out to the islands and back up to our beautiful mountains. It was a magnificent estate with rare trees and shrubs, a real showplace. Although Mrs. Child lost her husband, she continued to live there for a time, but finally she decided to give it to the Santa Barbara Foundation which, in turn, gave it to the city after Mrs. Childs passed away.

On the back of this beautiful piece of property ran the Southern Pacific railroad and here was established a kind of haven for the hobo populaiton. In fact, before Mrs. Child died she began to take a serious interest in these hoboes and permitted the establishment of a little city, a hobo village. They had protection there because she authorized their occupancy. They elected a mayor and a city council, and their little huts and hovels could be seen from the railroad with the estate and the big house in the background. It was truly a magnificent spot for a hobo; in fact, they lived in style. They came south for the winter and established their residence on the Child estate. They are still there to some degere, some seven or eight of the senior citizens are still living there. The place itself went to wrack and ruin after Mrs. Child died, and finally the city went to the Junior Chamber of Commerce and suggested that maybe they might have some ideas about it. The Junior Chamber of Commerce appointed a committee of two young men, one an attorney and the other the manager of a placement agency. They went down there, took a look at the site, and were impressed with its possibilities. They asked for some additional help on the committee and an engineer, a landscape artist, and an architect were added. They developed the idea of a recreational area, to be attached to the bird refuge. The property consists of about 81 acres, a beautiful area, right on the ocean.

They went back to the Junior Chamber of Commerce and indicated that they thought it had tremendous possibilities and asked for some money for further study. The Chamber gave them $10,000. They added two more people to the committee and pursued their study. Finally they came up with the idea of a small pet park, together with a children's playground, family picnic grounds, an amphitheater, and other developments of a recreational nature. They went back again to the Junior Chamber. The idea seemed to strike a responsive chord in all of these young men who, incidentally, have been a very vital factor in this community. In fact, the record of their accomplishments indicates that they have been actively involved in many of the fine things that have happened in Santa Barbara in the last 25 years. The Junior Chamber decided they would sponsor this idea and went to the City with their plan. The City agreed that it was a fine thing and here is where the "participation" really began to work.

They decided, naturally, that they needed a lot of money. They gathered together 600 people of the community at a banquet in this room just a year ago this month, and the money-raising campaign was started. The Junior Chamber committed itself to $50,000 and in the course of a few weeks just under

$200,000 had been raised for this project. Then a foundation was established, with leading business men of the community as trustees, to provide the administration and policy-making of this future project. In addition to trustees for the foundation, an advisory committee was selected, composed of architects, landscape architects, engineers, and veterinarians—about 25 of our leading citizens. A master plan was developed by a top professional group—people who, incidentally, had helped design Disneyland, as well as one of the outstanding recreational spots in the Oakland area. This master plan has been accepted by the Board of the Junior Chamber and has been tentatively approved by our City Council. Work has already started. For the past several weeks there have been volunteer work crews. We have bulldozers, scrapers, trucks—all of the heavy equipment necessary to do the type of job—volunteered by the various contractors of the community. The labor unions have participated in this project to the extent that all of the labor used on the bulldozers, scrapers, trucks, etc. has been volunteer service. The Junior Chamber itself has a crew of men there every Saturday and Sunday doing much of the hard work that has to be done on this kind of an operation. It is anticipated that May 15 will see the opening of the first phase of this project.

All of us in town who have a part in this project are, of course, very proud. We hope that many of you folks when you come back to Santa Barbara in the future will go to the park, make use of its facilities, and enjoy its beauty.

Now these few remarks about our favorite project will, I hope, serve to illustrate the three basic features that must characterize any successful program: (1) it must be a sound proposal; (2) it should be of value to a large segment of the population; and (3) it must stimulate broad and enthusiastic participation.

It has been a real pleasure for me to be here today. I was a little apprehensive about taking on this assignment in view of my preparing to retire, but now that I am here and now that I am through, I am very happy. Thank you.

Pres. Brawley: Thank you, Mr. Irvin. Let me assure you that we are most appreciative that you are here and we certainly thank you for this most unusual illustration in the matter of participation.

SECOND SESSION

MONDAY, JANUARY 28, 1:20 P.M.

LESTER R. BRUMBAUGH, *Presiding*

PANEL: NEW CONCEPTS APPLICABLE TO MOSQUITO CONTROL

RICHARD F. PETERS, *Moderator*

Mr. Peters: As has been mentioned, I have just recently returned from France. It is also true that I was in Paris but I didn't get out of the airport. More importantly, however, I did have an opportunity to visit Geneva, Switzerland where the World Health Organization was holding a worldwide conference on vector control. It was a rewarding experience to hear about the practices of vector control throughout the world. Primary emphasis was, of course, upon mosquitoes and the transmission of disease by mosquitoes. One impression I took from this meeting was that California's mosquito control program is unrivaled anywhere else in the world. I hope I represented the position of our program accordingly.

I purposely made this statement of commendation in behalf of our program before mentioning some of the hazards which confront associations with programs as effective and as complicated as ours. I can't help but feel that our program is fraught with certain potential complications. We have all recognized this in the area of insecticide resistance, for example. One major hazard certainly would be that of complacency. The risk of complacency is always present when one enjoys an effective technology. This tends to create an inertia about planning for the problems which lie ahead. I have always been impressed with the fact that the mosquito is a very susceptible animal, eligible to being dealt with in many ways besides the conventional ones we have come to employ in our present technology.

I am sure all of you know that the organophosphorus insecticides we are using today are not as certain as they were last year or the year before that. Thus, it is vital that we prepare ourselves accordingly, considering the possibility that we may again be called upon to put down another potential outbreak of mosquito-borne disease. We must be prepared to meet such a challenge.

It is also becoming increasingly clear that the fish and wildlife of the state cannot flourish in the presence of very high levels of pesticides; therefore, avenues of research are urgently needed to deal with the vast areas where multiple use of water is foreseeable.

I feel that the presentation to follow will concern itself with some of the conditions and considerations I have just mentioned. Our first speaker will be Dr. Donald E. Weidhaas, Assistant Chief, Insects Affecting Man and Animals Branch, Agricultural Research Service, U.S. Department of Agriculture.

HIGHLIGHTS OF RESEARCH ON CHEMOSTERILIZATION OF MOSQUITOES

DONALD E. WEIDHAAS
Agricultural Research Service,
U.S. Department of Agriculture

At present, control of disease-carrying and pestiferous mosquitoes depends on the reduction or elimination of larval breeding areas or the application of insecticides to larvae or adults. Satisfactory control can be achieved only by the continuing and extensive efforts of mosquito control organizations well trained in the complex techniques required.

That many insects, including several species of mosquitoes, can be rendered sterile by gamma radiation or by chemicals has been demonstrated in the laboratory. The development of these new techniques plus the successful eradication of the screw-worm *(Cochliomyia hominivorax* (Coquerel)) from Curacao and the Southeastern United States (Lindquist 1959, Knipling 1960) by the release of males sterilized by gamma radiation suggests that yet another method may be available for mosquito control. Theoretical considerations also suggest that sterilization may be more effective than killing for the control or eradication of certain insect species. It is the purpose of this paper to review the meaning of the term "chemosterilant," the ways in which chemosterilants may act on insect reproduction, the advantages that might be gained from their use, the results of research with chemosterilants and sterilization of mosquitoes, and the possible ways in which these sterilants might be used for control or eradication under practical field conditions.

The term chemosterilant can be defined simply as a chemical capable of causing sexual sterility, that is, failure to reproduce. This definition is general. It could include very diverse types of chemical action on insects, such as prevention of copulation. However, with regard to the chemicals presently known and studied, the term chemosterilant is restricted to compounds which prevent production of sperm or ova, kill sperm or ova that have already been produced, or damage chromatic or genetic material in the sperm or ova so that zygotes, if formed, do not develop into mature progeny. Geneticists call the last type of action "induction of dominant lethal mutations." Such action is desirable because sterilized males can, after treatment, remain fully competitive with normal or untreated males in mating with females. Fortunately, studies with the most promising chemosterilants have shown that sperm in treated males can remain motile and be transferred to the spermathecae of females during the mating process thereby satisfying the mating requirements of females. As will be pointed out later, this type of action is essential in the present concept of control or eradication through the use of sterility.

From the chemical rather than the biological point of view outlined above, compounds which have caused sterility in various species of insects have fallen into three major groups--alkylating agents, antimetabolites, and miscellaneous compounds. In general, but not without exception, the antimetabolites have been effective sterilants for females only, whereas alkylating agents have caused sterility in both males and females. Since present concepts and theories concerning the application of the sterility principle to practical control require that the males be rendered sterile, major attention has been given to studies of alkylating agents. Extensive screening of candidate compounds has shown that, among the alkylating agents, compounds which contain aziridinyl ring structures have been effective in producing sterility. Three compounds--apholate, 2,2,4,4,6,6-hexahydro-2,2,4,4,6,6-hexakis(1-aziridinyl)-1,3,5,2,4,6-triazatriphosphorine; tepa, tris(1-aziridinyl)phosphine oxide; and metepa, tris 2-methyl-1-aziridinyl)phosphine oxide--have been studied more extensively than any others.

For control or eradication, chemosterilants could be used in two ways--to sterilize insects for release into natural populations or to treat natural populations. The second use would eliminate the costly, extensive, and sometimes impossible task of rearing and distributing large numbers of insects. In addition to the possibilities for control or eradication, chemosterilants provide a genetic tag which can be very useful in biological and ecological studies of natural or laboratory populations. In attempts to devise, develop, and implement new approaches to insect control, it has become obvious that more fundamental and precise information must be obtained on natural populations--their size, distribution, biology, ecology, reproductive potential, and mating habits.

Sterilizing populations of insects may offer certain theoretical advantages over killing them with insecticides (Knipling 1959). To illustrate these advantages, one can assume that a certain proportion of a natural population, e.g., 90%, can be reached with a chemical treatment that either kills or sterilizes and that this natural population, unchecked, would be able to increase by 10-fold each generation. With an insecticide treatment which kills 90% of the insects, the 10% of the population which survives will maintain itself at its original level with no reduction in numbers from generation to generation even though 90% of all progeny is killed. With a chemical treatment that sterilizes 90% of the population, one can also assume that 10% would escape sterilization. However, unsterilized females (10%) will be subject to mating with sterile males and normal males that would be present at a ratio of 9 sterile males to 1 fertile male. Consequently, 99% of each generation would be affected by the treatment and a reduction of 90% of the remaining population from generation to generation could then occur. In addition to this "bonus effect," other factors could increase the advantages of sterilization over killing with an insecticide. If males move over any distance and survive for any length of time, there could be a "space" as well as a "time" effect. These two factors would be extremely important when population levels are low--at which time insecticides are very inefficient.

First experimentation with the induction of sterility in mosquitoes was undertaken because of the successful development of the sterile-male technique with screw-worms. Davis *et al.* (1959) showed that *Anopheles quadrimaculatus* Say, the common malaria mosquito, could be sterilized by exposure of either pupae or adults to gamma radiation from a Co^{60} source. However, the sterilized males were not as competitive as normal males in mating with normal females. *Aedes aegypti* (L.), the yellow fever mosquito, was also sterilized by gamma radiation in laboratory tests; again the sterile males were not as competitive as normal males (McCray *et al.* 1961). Subsequent field tests in which males sterilized by gamma radiation were released into natural populations, to study their ability to induce sterility in or reduce the numbers of these populations, failed to demonstrate the practicability of the method with either *quadrimaculatus* (Weidhaas *et al.* 1962) or *aegypti* (Morlan *et al.* 1962). Dame and Schmidt (1962) have reviewed the possible reasons for the lack of success in the preliminary field experiments in which sterile males were released.

During the time that laboratory and field experiments with radiation for the sterilization of mosquitoes were being conducted, LaBrecque *et al.* (1960) and LaBrecque (1961) found chemicals capable of causing sterility in both sexes of house flies. With this finding, studies on chemosterilization of mosquitoes were initiated (Weidhaas *et al.* 1961. Weidhaas 1962, Weidhaas and Schmidt 1963).

Approximately 20 compounds which caused sterility in house flies have been tested against mosquitoes. Research has been conducted, for the most part, with three chemosterilants – apholate, tepa, and metepa – and three species of mosquitoes – *quadrimaculatus*, *aegypti*, and *Culex tarsalis* Coquillett. Laboratory testing has utilized suitable crosses of treated (T) and untreated (Unt) males and females (T♂ x T♀; Unt♂ x Unt♀; T♂ x Unt♀; Unt♂ x T♀; Unt♂, T♀ x Unt♀). The general scheme of evaluation employed was as follows: (1) the candidate compounds were screened for their effectiveness; (2) the minimum effective sterilizing dose and the maximum tolerated dose were ascertained; (3) the effects on each sex were noted; (4) different methods of application were tested; and (5) survival and competitiveness of sterile males were determined.

In general, both sexes of *aegypti and quadrimaculatus* have been sterilized chemically by the following methods: (1) feeding newly emerged adults on honey-water treated with the chemosterilants; (2) allowing adults to rest or walk on residual deposits; and (3) exposing larvae to chemosterilants in water. Apholate, tepa, and metepa sterilized both sexes when fed to adults at concentrations in honey-water ranging from 0.1% to 1%. Tepa and metepa sterilized mosquitoes when adults were exposed to residual deposits for periods varying from 1 to 4 hours. Residues used were 10 mg. per square foot of glass surface or 100 to 500 mg. per square foot of masonite panel. In these tests newly emerged males and females were used. An interesting effect was noted with females containing fully developed eggs or partially digested blood meals. These famales had previously mated and already deposited as many as 1 to 3 or 4 batches of viable eggs.

The new batches of eggs were rendered completely nonviable by 4-hour exposure of these adult females to residual deposits of tepa (500 mg. per square foot of masonite panel). With apholate *quadrimaculatus* adults could not be sterilized by contact with residual deposits at dosages or exposure times equal to or even 2½ times those used with tepa.

Complete or partial sterility has been induced in both sexes of *Aedes aegypti* when late third or early fourth instar larvae were exposed until pupation to 10 p.p.m. of apholate or tepa in the rearing water. Preliminary studies showed that males sterilized with either tepa or apholate by tarsal contact or by adult feeding were equally competitive with normal males and more competitive than males sterilized by gamma radiation.

Studies with p^{32}-metepa (Plapp *et al.* 1962; Dame and Schmidt, in press) showed that metepa was rapidly absorbed and metabolized by *Culex tarsalis*, *Anopheles quadrimaculatus*, and *Aedes aegypti*. Degradation of metepa was substantially complete within 48 hours after administration to larvae and within 24 hours to adults.

At present it is difficult to envision a means of using chemosterilants against natural populations of mosquitoes. The applicability or practicability of the release of sterile males to mosquito control has not been demonstrated as yet. Further research on biology, population dynamics, and migration of mosquito species is needed. Also, investigations of a combination of methods, including source reduction, application of insecticides, and sterile-male release should be undertaken. Applying chemosterilants against natural populations may be possible, since mosquitoes can be sterilized as adults by feeding or by tarsal contact or by exposing the larvae in water. A lure or attractant may be found to bring adults to baits or residual deposits. Because of the possible hazards to other animals and man, the treatment of breeding water may be undesirable. Further research on the effectiveness and hazards of such treatments as well as the development of mosquito attractants should be made. Limited field and outdoor-cage studies with tepa as a residual deposit and apholate as a larval treatment showed that the effectiveness of these materials was lost rapidly. Thus, considerable research is necessary to develop methods in which this new approach to insect control can be used effectively, safely, and economically for the reduction or elimination of disease-carrying or pest mosquitoes.

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RESEARCH ON BIOLOGICAL CONTROL OF MOSQUITOES

WILLIAM R. KELLEN

California State Department of Public Health, Bureau of Vector Control, Fresno

Biological control is not a new concept, but its possible application to mosquitoes and other arthropods of public health importance is receiving more attention today than at any time in the past. The reason for this increased attention to biological control has been the recognition that repeated applications of chemical insecticides cannot provide long-term solutions to continuing problems concerning mosquito control; in fact, chemicals may even create new problems, such as development of resistant populations, formation of undesirable residues, and poisoning of beneficial insects and wildlife. However, chemical control provides us with temporary control and the time to explore and develop more permanent measures to reduce mosquito populations below economic levels. Many believe that the key to such long-term control will be provided by biological control and source reduction, through proper water and land management.

Biological control, according to the definition of the Department of Insect Pathology, University of California, is the use, by man, of living organisms to control undesirable insects, animals, or plants. Certain nonorganismal biological factors, such as metabolic and genetic diseases or the use of males sterilized by chemicals or gamma radiation, may be included in the biological control concept when they are used for controlling pests.

That phase of biological control which is under investigation at the Fresno facility of the Bureau of Vector Control concerns the microorganisms pathogenic to mosquitoes. The use of such pathogens for control is called microbial control.

Microbial control seeks to utilize such microorganisms as viruses, bacteria, fungi, protozoa, and nematodes in the fight against mosquitoes. Jenkins (1960) reported that about 500 species of parasites are known to attack arthropods of public health importance. Many of these naturally occurring control agents are pathogens of mosquitoes. If it were possible to establish a control program based on such microbial agents, there would be no problem with toxic residues, no danger of destroying beneficial insects and wildlife, there would be considerably less difficulty with the development of resistant mosquito populations, and finally, such a program would provide long-term benefits.

Unfortunately, naturally occurring pathogens of mosquitoes usually attack relatively small proportions of wild populations, and only occasionally reach epizootic levels. However, if we understood the details of their host-parasite relationships and the role certain ecological factors may play in disease transmission, it is possible that we may be able to manipulate certain factors to encourage epizootics in mosquito populations. Since many pathogens have resistant resting stages, disease agents would become permanently established in mosquito breeding habitats. Furthermore, it may be possible to rear certain pathogens artificially in the laboratory in large numbers for distribution to new areas, or it may even be feasible to introduce mosquito pathogens from foreign countries to establish new mosquito diseases in California. Dr. Marshall Laird of the World Health Organization demonstrated a few years ago the feasibility of introducing and establishing mosquito pathogens from foreign countries. Dr. Laird obtained resting sporangia of *Coelomomyces stegomyiae* from Singapore and introduced them to a South Pacific island to combat certain *Aedes* mosquitoes which vector filariasis. The fungus was successfully established and after two years had invaded a relatively large number of mosquito breeding habitats. The influence exerted by the new pathogen on the total mosquito population was not assessed, but many infected larvae were observed where none had existed previously.

There is no risk involved in importing such exotic disease agents, as they are exclusively pathogenic to mosquitoes. Most frequently, imported biological control agents are used to combat introduced pests which become established without their normally associated pathogens, parasites, or predators; however, it has been demonstrated that such introduced agents may be highly effective in controlling species closely related to their native hosts. It is very desirable, however, first to have a thorough knowledge of the biological control agents naturally occurring within the range of the pest species. Such a study of mosquitoes has been initiated in California.

Coelomomyces

A continuing survey of mosquito populations in California has demonstrated that at least one of the 19 species of a fungus pathogenic to mosquitoes, *Coelomomyces*, occurs in the state. Adult females of *Aedes melanimon* and *Culiseta incidens* have been found infected with *Coelomomyces psorophorae*, but diseased larvae have not been observed. Infected females studied in our laboratory had ovaries damaged or entirely replaced by resting sporangia. Presumably these infected adults acquired infections while in the larval stage, but the pathogenic influence of the fungus was not expressed until the host reached the adult stage. The infected females appeared normal and healthy, but their reproductive capacities were destroyed. We believe that *Coelomomyces* is one of the more promising pathogens for biological control, and we are investigating its mode of transmission and host specificity in the laboratory.

Microsporidia

Microsporidia (Protozoa) are common pathogens of mosquitoes in California. Although eggs, larvae, pupae, and adults may be infected, the disease is most easily recognized in larvae because of certain conspicuous changes in body shape and color which usually accompany advanced stages of infection. Diseased larvae with such apparent infections are frequently observed in California.

Larvae with apparent infections usually succumb before pupation. Larvae with inapparent infections may not be affected adversely and may survive apparently normally to the adult stage and transmit infections to their progeny transovarially.

The most commonly observed pathogens of mosquitoes in California belong to the genus *Thelohania*. The following mosquitoes are attacked by at least two species of *Thelohania: Culex tarsalis, C. apicalis, C. peus, Culiseta inornata,* and *Aedes cinereus;* dual infections have been observed in *C. tarsalis* and *A. cinereus*. At least one species of *Thelohania* is known to occur in *Culex thriambus, C. erythrothorax, Culiseta incidens, C. particeps, Anopheles pseudopunctipennis franciscanus, Aedes melanimon, A. increpitus, A. cataphylla,* and *A. ventrovittis*.

Two species of *Nosema have been observed in larvae* and adults of *C. tarsalis* and *A. p. franciscanus*, while mixed infections of *Nosema* and *Thelohania* have been frequently observed in *C. tarsalis*. One species *Plistophora* is known to attack adults of *Culiseta incidens*.

Data from collections made in various parts of California indicate that Microsporidia usually occur wherever populations of their host species exist; however, levels of apparent infection may vary considerably even in closely associated larval populations. Seasonal changes in levels of infection presumably occur, but little information is available on this subject.

Samples from infected larval populations indicate that levels of apparent infections with *Thelohania* usually range from about 5% to less than 1%; however, populations of *C. tarsalis* with about 15% apparent infections have been frequently sampled, while several larval populations of *C. incidens* with about 80% apparent infections have been observed.

Although host specificity has been difficult to demonstrate in the laboratory, there is evidence to suggest

that many, perhaps all, of the *Thelohania* from mosquitoes are host specific. It has not been possible in the laboratory to transmit *Thelohania* to healthy larvae or adults of known hosts by exposing them to spores; similarly, attempts to infect larvae by exposing them to tissues of individuals which had succumbed to the disease have been negative. Soil and water samples taken from areas in the field known to harbor diseased larval populations have been tested and found noninfective. Evidence for host specificity, therefore, has been based entirely on field observations of mixed populations of different species of mosquito larvae infected with different *Thelohania*. Unfortunately, determination of host specificity is further complicated by the many species of *Thelohania* which are morphologically similar and must be identified on the basis of slight differences in spore shape and size. The diagnostic value of certain cytological characteristics of developmental stages of *Thelohania* has not been demonstrated.

Host-parasite relationships between mosquitoes and *Thelohania* are not simple, nor may the same or even similar relationships exist for each species of host and pathogen. Studies of *C. tarsalis* infected with *T. californica*, for example, have demonstrated that the sex of the host may play a very important role in host-parasite relationships: Eggs laid by infected *C. tarsalis* may contain from one to about 50 mono- and binucleate trophozoites of *T. californica*. First and second instar sibling larvae from infected egg rafts do not exhibit apparent signs of their infections. Late in the third larval stadium, however, male larvae begin to develop conspicuous white areas in the thorax and abdomen. Such white areas are created by masses of pathogens undergoing sporogony in the tissues of the host. The male larvae become packed with masses of spores and succumb to their infections late in the fourth larval stadium. Sister larvae develop normally and do not show apparent signs of their infections; they pupate normally and emerge as apparently healthy adults. Infected females of *C. tarsalis* do not harbor spores. They suppress the sporogonic cycle of *T. californica* and survive to transmit infections to their progeny transovarially.

Infected egg rafts of several species of mosquitoes have been collected in the field and reared in the laboratory. Observations of infected eggs have indicated that host-parasite relationships of different species of mosquitoes, notably *Culex apicalis*, *C. erythrothorax*, *C. peus*, *C. thriambus*, and *Culiseta incidens*, are not similar to that observed in *C. tarsalis*.

Infected rafts of *C. incidens* observed in the laboratory gave rise to sibling larvae which suffered 100% mortality in the fourth larval stadium; larvae developed apparent infections and massive accumulations of spores. In contrast, infected sibling populations of *C. erythrothorax* and *C. thriambus* suffered very low levels of mortality and only a relatively few individuals developed apparent infections.

Infected eggs of *C. peus* gave a rise to larvae with apparent infections, but such individuals frequently survived to the adult stage; however, these surviving adults did not transmit infections to their progeny transovarially. *C. apicalis* larvae infected with *T. benigna* usually survived their apparent infections, and transovarian transmissions of the pathogens have been observed in the laboratory. The details of these relationships have not been studied.

The influence of inapparent or sub-lethal larval infections on the fecundity, behavior, and survival of resulting adults are little known, and it is obvious that much remains to be learned about mosquitoes and their microsporidian pathogens before we can evaluate the role Microsporidia plays in the natural regulation of mosquito populations. Moreover, studies are continuing to determine the possibility of establishing new infections in wild populations by exposing larvae to the resting spores of Microsporidia.

Virus

In our laboratory many larvae of *Culex tarsalis* infected with a possible polyhedrosis virus have been observed, and certain preliminary studies have been conducted to elucidate the pathology and mode of transmission of the disease. Infected fourth instar larvae were first collected from small stagnant ponds in an irrigated pasture in Madera County. Many of these larvae became moribund in the laboratory. Their abdomens became abnormally curved or S-shaped, and the lateral thoracic areas and anterior abdominal segments became inflated with hemolymph. Developing adult structures, such as wings, legs, antennae, and mouth parts were partially destroyed or malformed, while the thoracic cuticle and occasionally certain of the abdominal segments developed hard, shiny black spots about 50-100 microns in diameter. Larvae exhibiting these signs invariably died in the fourth instar, and usually remained attached to the water surface after death. Tetragonal inclusion bodies were observed in nuclei of hypodermal cells and developing adult leg, wing, and antennal buds. Several tests were performed in the laboratory to determine the infectivity of inclusion bodies and diseased larvae, but consistent transmission was not obtained. It was concluded that an infective agent was present, and possibly it was a nuclear polyhedrosis virus.

Many other pathogenic bacteria and fungi have been isolated from various species of mosquitoes in California, and investigations concerning their host-parasite relationships, distributions and season incidences are continuing. If such diseases can be successfully established in laboratory colonies of mosquitoes, opportunity will be made available to study factors influencing their transmission and to evaluate the feasibility of applying them in biological control.

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SIDE EFFECTS OF PEST CONTROL PROGRAMS ON WILDLIFE

ELDRIDGE G. HUNT
Game Management Branch,
California State Department of Fish and Game

The benefits and liabilities of pest control programs involving the use of modern agricultural chemicals has been widely discussed in recent months. Interest in this subject has been stimulated by publicity referring to the unwise use of pesticides and the resulting side effects on nontarget animals. In reply to the claims of misuse and unjustifiable loss of beneficial animals have come counter claims pointing out the benefits derived from the use of pesticides and the precautions taken to protect the public from adverse effects of these toxic materials. The controversy over the desirability of the widescale application of certain groups of pesticides is continuing. However, it is generally conceded that pesticides widely used, have contributed to the public good and their use will be continued. Along with this acceptance of continued pesticide usage has come a demand for the appraisal of the side effect of pesticide use on man, his wild and domestic animals and their environment. My presentation today will pertain to the side effects of pest control programs on some wildlife species and their environment.

The effects of toxic materials on wild animals may be classified as being either direct or indirect. Direct effects result in death or debility shortly after exposure to a toxic chemical. These reactions are usually related to a single exposure to a highly toxic chemical or a chemical of moderate toxicity applied at a high rate.

In California the reported losses of nontarget fish and wildlife from the direct effects of pesticides is small considering the tremendous amounts of toxic materials applied to areas inhabited by fish and wildlife. This observation is based on recent field investigations by Department of Fish and Game personnel and information regarding fish and wildlife losses submitted to our Department by private individuals and other agencies. However, in addition to the known losses there were undoubtedly some instances where losses have occurred that were either not discovered at all, were not attributed to poisons, or were not discovered in time to determine cause of death. We believe the judicious regulation of the use of agricultural chemicals by the county and state departments of agriculture are largely responsible for holding wildlife losses from direct poisoning at a low level.

The indirect effects of pesticides on fish and wildlife are of the greatest concern to our Department. These effects like direct effects may also result in death or debility to an animal. However, they are usually more insidious in action and may not become apparent for a lengthy period of time after exposure. These effects most often follow multiple exposures to chemicals of sublethal toxicity. The end result may be death or weakness of an animal or a physiological impairment such as the suppression of reproduction.

The toxicants involved in this type of poisoning are usually of low acute toxicity, many are accumulative in action and some can be stored in animal flesh. These properties are found especially in certain members of the DDT family of insecticides.

There are four major categories of indirect effects. The first has to do with faunal displacement. Examples of this are seen when the chemical control of one species results in the increase of another species to the extent of the latter becoming a pest. This occurs most often with insects. Some biologists believe that the predator-prey relationship of forest and range animals is effected by this phenomenon. For example, the drastic suppression of predators of rodents by poisoning may be a factor in causing a population explosion of rodents.

The second category of indirect effects of poisons on wildlife pertains to chemical alterations—specifically, the alteration of a control chemical to a different material. This alteration can take place in the environment or in an animal body. Examples are the conversion of heptachor to heptachlor epoxide in the bodies of wild animals. The epoxide has been found to be up to four times as toxic as the parent compound to some animal species (Negherbon 1959).

The third category of indirect effects involves the interference with the food chain. The removal of a food source from the toxic effects of pesticides is a dramatic example of food chain interference. A specific example is the reduction in the population of Atlantic salmon in the Miramichi River, New Brunswick, due to the destruction of the food source of this fish by DDT (Keenleyside 1959).

Another potential hazard involving the food chain arises from the assimilation and transfer of a toxic chemical from one organism to another. Secondary poisoning of dogs or coyotes by 1080 poisoned squirrels is an example of "food chain" poisoning. Secondary poisoning in this case is due largely to the fact that dogs and coyotes are very susceptible to the toxic effects of 1080. The amount of 1080 contained in the body of one poisoned squirrel is often enough to kill a coyote.

A similar type of poisoning involving the transfer of a toxic chemical from one organism to another in the food chain may occur involving certain members of the DDT family of insecticides. In this case the amount of toxicant in various organisms may build up slowly over a long period of time. The fact that most members of the DDT family do not break down rapidly after application indicates that they may provide a focus for contaminants for years. Most chemicals in this group are also fat soluble and are readily absorbed into fatty tissue. Recent studies have indicated that when DDT and other chlorinated hydrocarbons are introduced into water they are rapidly removed from the water by various living organisms and by detritus (Holden 1962; Hunt and Bischoff 1960). It is believed that the greater amount is taken up by living organisms. These organisms may vary in size from microscopic plankton to large vertebrates that inhabit the aquatic environment. It has been found that various aquatic animals have concentrated chlorinated hydrocarbon insecticides in their bodies to levels over a hundred thousand times the calculated rate of application. The Department of Fish and Game has conducted two studies that illustrate the accumulation of DDD and toxaphene by

various members of a food chain. These studies were made at Clear Lake, Lake County and Big Bear Lake, San Bernardino County.

DDD was applied to Clear Lake in 1958 for gnat control at the rate of 1 part of toxicant to 50 million parts of water (.02 ppm). DDD residues as high as 10.9 ppm were found in plankton, 983 ppm in plankton-eating fish, 2,690 ppm in carnivorous fish and 2,134 ppm in fish-eating birds. The residue levels found in these food chain organisms ranged from approximately 500 to 130,000 times those of the calculated rate of application.

Toxaphene was applied to Big Bear Lake at the rate of .2 ppm for the control of rough fish. Residues of this toxicant were found in plankton at levels of 73 ppm, in goldfish at 200 ppm and in the fat of a pelican at 1,700 ppm. This represents an increase of from 350 to 8,500 times the calculated rate of application.

The fourth category of indirect effects concerns reduction in reproductive potentials resulting from the ingestion of toxic chemicals. The suppressive effect on the reproduction of birds of DDT and other chlorinated hydrocarbon insecticides has been demonstrated in tests with penned quail and pheasants conducted by biologists of the U.S. Fish and Wildlife Service (DeWitt 1958; DeWitt and George 1959). In one series of tests it was found that bobwhite quail whose diet contained 90 ppm of DDT, produced eggs whose fertility was 30% lower than that of control birds. They produced 33% fewer chicks per hen and 800% more cripples than did quail on diets uncontaminated by DDT. More than 90% of the chicks from treated birds died within six weeks, even though pesticides were not fed to the chicks themselves.

In 1962 the Department of Fish and Game conducted a pilot study to explore what effects, if any, DDT used in rice culture had on reproduction in wild pheasants, and also what levels of chlorinaed hydrocarbon residues were present in tissues of these birds (Hunt and Keith 1963). Briefly, information on effects on reproduction were obtained by comparing the production of viable young from a population of pheasants residing in an area where no insecticides were used with those from an area where insecticides were applied in normal agricultural practices. To start the study, pheasant nests were located in both areas. After a clutch was laid the hen and eggs were collected. The eggs were placed in an incubator and tissue samples for insecticide residue analyses were taken from each hen. Eggs were incubated and the resulting young raised in pens to six weeks of age. A loss after hatching of young from the area treated with insecticide was approximately twice as great as that in the control area. Because eggs and young from areas received the same treatment during the hatching and rearing process, the difference in loss was tentatively attributed to insecticides.

Residues as high as 3,000 ppm DDT were found in fatty tissue of one of the parent birds. A level of DDT in excess of 1,000 ppm was found in one of the egg yolks and residue in excess of 200 ppm was found in a chick that died shortly after hatching. The results of this study suggest that the transfer of large amounts of residues from the female to the young through the egg significantly lowered the number of viable young produced.

We hope that this presentation has contributed to an understanding of some of the different ways that wildlife can be affected by modern pesticides. It is important to remember that the problems at Richvale, Clear Lake and Big Bear Lake occurred following application of insecticides at either recommended levels or, in the case of the lake treatment, at lower levels than would be used normally for insect control in a terrestrial situation. Our studies have just scratched the surface in the understanding of indirect effects of the long lived chemicals on wildlife. We do not know the extent of these problems. We have learned that there are some serious problems associated with the use of the DDT group of chemicals in particular, and we have been able to define certain problem areas. We intend to continue working in these problem areas and hope that our findings will be of value to you in planning your mosquito suppression programs.

In control programs there is a natural tendency to concentrate on the target animals with little consideration given to side effects and long term ecological factors. We have noted that in mosquito control activities in this state there has been an awareness of side effects exhibited which is certainly above the level of that shown by many control agencies. The recent Yosemite Conference on Wildlife Management and Mosquito Suppression was witness to this fact. In closing we wish to urge that you continue to look at the broad picture in your control activities. Our goal should be to maintain an environment amenable to both human beings and wildlife.

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PANEL: RELATED PROBLEMS OF INTEREST TO LOCAL CONTROL AGENCIES

NORMAN F. HAURET, *Moderator*

Mr. Hauret: This afternoon's panelists will try to consider some of the problem areas other than mosquito control with which local agencies are sometimes

faced. We are all obliged to ask ourselves from time to time how we relate to these types of problems, whether they are being adequately met by other agencies, and whether we have a responsibility to undertake a broader approach to vector control.

Dr. Leo Kartman of the U.S. Public Health Service, who has had a great deal of experience in laboratory work and field epidemiological studies in vector control, will present the first subject.

"MICE THAT MAR THE LAND"—A UNITARY VIEW OF PUBLIC HEALTH AND VECTOR ABATEMENT[1]

Leo Kartman

I would like to begin with a few words about ecology. This seems to be absolutely necessary these days if one sets out to discuss biological, medical, or even sociological problems. As a matter of fact, in at least one country certain ecologic precepts have been elevated to the status of a doctrine.

I take it that, in the ecological view, one must subscribe to the philosophy of wholism and look at the total environment, the ecosystem. The natural world offers us a picture of competition and dependency, a world where no organism is alone. Thus, as Tansley (1935) put it, the ecosystem is the "interaction system comprising living things together with their nonliving habitat . . . including 'not only the organism-complex, but also the whole complex of physical factors forming what we call the environment'" (see Evans 1956).

It would be out of place here to go into a more elaborate explanation of the nature of the ecosystem. What is implied for us is the obsolescence of the idea of compartmentalizing such concepts as vector and reservoir, host and parasite, or the problems of public health, agriculture, industrial practice, anthropology, and perhaps even psychology. More than that, it should be perfectly clear to everyone that man sits on top of this natural pyramid and most of his activity is occupied with manipulating the ecosystems with which he is concerned. Accordingly, in public health, although attention must be given to the most pressing problems first, be they vectors or reservoirs· it is well to think of vectors and reservoirs as emerging from the same Pandora's box in the household of nature. Ultimately, all vector-reservoir problems must be surveyed, reported, managed, and eliminated where necessary. This refers not only to vectors in the conventional sense but also to streams, air currents, fecal matter, and other inert carriers as exemplified by the section in *Biological Abstracts*, under Public Health, termed "Disease Vectors—Inanimate."

I would like to put these strictures somewhat aphoristically as follows: the cognizance of a single vector problem is the recognition of all vector problems, and is at the same time the problem of their transformation. By this I mean simply that as observers and manipulators of certain factors in the ecosystem, recognized as being noxious to mankind, we are morally bound to transform all such factors in a manner that, within a sound ecological scheme, will prevent their disruptive and destructive effects on the human enterprise.

Let me illustrate by way of a personal experience. During World War II, I spent a considerable period in malaria survey and control work in the Africa-Middle East theatre. We were engaged in treating huts in a village near Dakar, French West Africa, with DDT sprays for control of anopheline mosquitoes. The work had progressed well for several days when an elderly African man came by and asked me to follow him to his hut. When we were inside, he very carefully pulled his bedding aside and pointed out scores of bedbugs in the wooden frame. Then he scooped up a handful of sand from the floor and this literally was alive with fleas. "These are terrible creatures," he said. "Surely sir, if you are already spending your time killing the mosquitoes, can you not also kill their cousins?"

In practical terms, my brief excursion into ecologic ideas relates directly to the recognition by your Association, some time ago, that its objectives aim to promote cooperation among those concerned with· and interested in, subjects related to mosquito control. I presume that these "related subjects" are not only gnats, flies, wasps, and other arthropod pests and vectors, but also rodents, bats, birds, and other vertebrates intimately linked to the arthropod vector or in themselves harmful to man's well being. Thus, by "mice that mar the land," I refer not only to rodents, but to all vertebrate pests that represent a threat to our land, our human population, our socio-economic prosperity.

As you all know, the laws in the California Health and Safety Code (1961), relating to mosquito abatement districts and mosquito control, specifically refer to the raising of funds for, and the administration by district boards of, the destruction and extermination of rats. Accordingly, it does not appear unrealistic for your interests and activities to become integrated in what is referred to as vertebrate pest control (Howard 1962). The great variety of problems in this area is illustrated by the wealth of material presented at the first California Vertebrate Pest Control Conference (1926) held at Sacramento a year ago.

Historically, it is probably true that the initial type of rodent control work primarily had economic objectives. During the first decade of this century the federal biological survey program was mainly concerned with studies of birds and mammals in their economic relation to agriculture and stock raising. In that period there was a growing cooperation among farmers to control rodents in Kansas, for example, and successful poisoning campaigns were carried out in the Nevada mouse plague of 1908-09. It was during the same period that strychnine formulations were developed for the control of ground squirrels.

The record suggests, however, that a stronger impetus to vertebrate pest abatement was given by the discovery of the essential role played by certain ani-

[1] From the U.S. Department of Health, Education, and Welfare, Public Health Service, Communicable Disease Center, Technology Branch, San Francisco Field Station, San Francisco 18, California.

mals in zoonoses such as plague, Rocky Mountain spotted fever, and rabies. In consequence, the Federal Public Health Service authorities sought improvement in field control techniques and they initiated investigations in the natural history and epidemiology of several diseases. Plague was probably the first disease to come under systematic study and the Public Health Service has continued the work to the present time.

In California, as early as 1909, a state law was enacted giving authority to local health agencies to enforce the control of ground squirrels. Later, in 1917, a state law was passed that designated rodent control to be a specific function of the agricultural regulatory machinery. Section 139.5 of the Agricultural Code authorizes control of field rodents "in which diseases transmissible and injurious to humans are reservoired."

What are these diseases? It is no news to you to be told that rodents are involved as hosts of a number of zoonoses. Ever since the early urban, rat-borne epidemics of plague in San Francisco stimulated interest in that disease, the infection has been found in many areas of the state in wild rodents. Figure 1 shows the distribution of the infection in a variety of rodents and their ectoparasites throughout the state from 1927 to 1961. Since 1927 there have been only 17 authenticated human plague cases in California. Up to 1915 about 24 human cases were attributed to ground squirrels in the San Francisco Bay area (Meyer 1942). The source of exposure in human cases since 1927 is shown in Table 1. These cases were associated with ground squirrels, chipmunks, marmots, and rabbits in that order of importance. Only in the Yreka case in 1942 were field mice suspected.

Field mice, nevertheless, appear to play a very special role as reservoirs of plague infection. Rodents like *Microtus* and *Peromyscus* seldom are noted dying from plague, but they and their fleas are known to be involved in the enzootic maintenance of plague foci. These foci can be thought of as hot beds of infection with *Pasteurella pestis* rather than as pools of plague—the disease. Occasional tidal waves of disease may form in this sea of infection due to ecologic conjunction of a number of complex natural phenomena. Thus, in viewing the problem of control, it is important to distinguish between the management of rodent populations to a level wherein disease is eliminated, or of controlling a population to the level of eradicating infection.

Mention of plague, of course, conjures up visions of commensal rats. Fortunately, rats appear not to have been associated with human plague infections in California since the early decades of this century. Nevertheless, just a few years ago we found an infected *Rattus norvegicus* in northern San Mateo County, the infection having been acquired by contact with an epizootic focus in which *Microtus californicus* was the principal rodent population (Kartman *et al.* 1960). The data also showed that rats, invading territory occupied by *Microtus*, were infested with wild rodent fleas (Stark and Miles 1962).

The first clear-cut evidence of transfer of plague infection from wild rodents to commensal rats in California was reported by Meyer and Holdenried (1949). Their study established the existence of plague in *Citellus beecheyi*, *R. norvegicus* and *R. rattus* ssp. on a ranch near Santa Paula, Ventura County. The evidence indicated that the infection had been transferred from the ground squirrels to the rats via squirrel fleas.

There is much evidence that a transfer of fleas takes place among rodent hosts both intra- and interspecifically. Our laboratory conducted field tests with *Microtus* fleas tagged with a radioactive isotope, Cerium[144], in which it was shown that daily transfers of fleas from vole to vole occurred over a period of several weeks (unpublished). Transfer of fleas from voles to commensal rats also was observed in these studies (Hartwell *et al.* 1958).

In suburban areas, state parks, recreational areas, ranches, and around refuse dumps, ground squirrels, field mice, and other wild rodents commingle with commensal rats. Under these circumstances an exchange of fleas may at times be the means for transfer of plague infection and thus endanger the public health. In a situation of this type, the commensal rodent must be considered an essential link in the chain of infection from nature to man. Consequently, if the human community is to be protected, an attack must be made to reduce or exterminate rat populations and their ectoparasites.

As far as I have been able to determine, the current information on commensal rats in California is, with few exceptions, rather uncertain. For a number of years, the Bureau of Vector Control, California Department of Public Health has carried out surveys of commensal rodents in refuse disposal sites serving several communities of western Fresno County. Reports (1957, 1959) to the Health Officer, Fresno County Health Department, generally indicate a continuous infestation of *R. norvegicus* during the period 1956-1958 (Table 3).

> "Interest in these dumps was heightened in the late fall of 1956 with the discovery of *Xenopsylla cheopis* on Norway rats from Firebaugh and Mendota. Trapping at Firebaugh had revealed high densities of rats; those at Mendota were not so numerous.
>
> "A survey of other Westside dumps was undertaken to see if this flea was abundant elsewhere. Trapping at Dos Palos, Tranquility, and San Joaquin disclosed that each of these open refuse dumps also had high Norway rat populations but, with the exception of San Joaquin, no further occurrences of *X. cheopis* were noted.
>
> "This situation is of interest because of the establishment of *X. cheopis* populations in a generally arid inland environment. Interest is further heightened because of the high densities of Norway rats occurring on all of these open refuse dumps. All fleas submitted for plague testing were found to be negative, however.
>
> "Associated with the Norway rats were *Peromyscus maniculatus* and *Mus musculus* populations. Other flea species recovered were *Leptopsylla segnis*, *Monopsyllus wagneri* and *Nosopsyllus fasciatus*. Animals infrequently captured included *Microtus californicus*, *Reithrodontomys megalotis* and *Citellus beecheyi*.

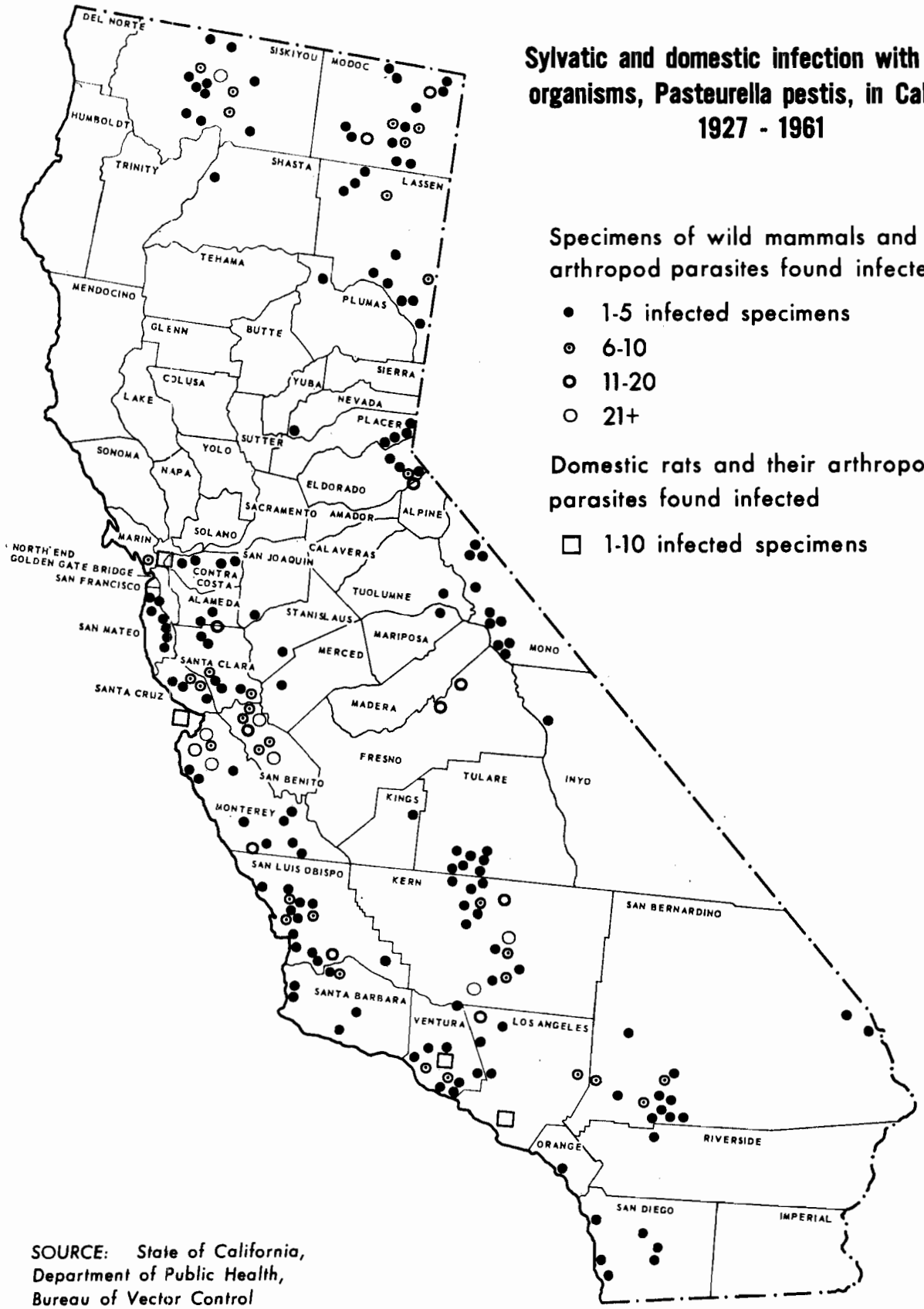

Figure 1. Distribution of animal plague infection in California.

TABLE 1.—Human plague cases in California, 1927-1962, and their probable source of exposure[1]

Year	*Location*	*Exposure*
1927	Near Clayton, Contra Costa County	Plague-infected ground squirrels found in vicinity. (16% of 147)
1928	Fort Ord, Monterey County	Soldier camped where plague found earlier in ground squirrels.
1928	Near Santa Ynez, Santa Barbara County	Evidence of ground squirrel epizootic.
1928	Santa Cruz County	?
1933	Big Bear, San Bernardino County	Man had visited cabin; evidence of ground squirrels. Epizootic possible.
1934	Poso Creek, Tulare County	Boy visited ranch where plague-infected ground squirrels found.
1936	Lake Tahoe, Placer County	Woman buried dead chipmunk week before.
1936	28 mi. N. San Simeon, Monterey County	Boy cut hand while cleaning brush rabbit.
1937	Huntington Lake, Fresno County	Girl bitten by chipmunk.
1941	Near Montague, Siskiyou County	*C. beecheyi* population in area had been heavy, almost disappeared just before onset.
1941	Mt. Shasta, Siskiyou County	Squirrels and chipmunks in area; dead squirrel seen week before. No obvious epizootic.
1942	Near Yreka, Siskiyou County	Child played in hay hauled in from area of prior ground squirrel plague. Mouse carcasses found in hay. Marmots had disappeared in vicinity.
1947	Fitzhugh Ranger Station, Modoc County	Boy had handled sick marmot.
1949	Jess Valley, Modoc County (not confirmed by laboratory)	Girl had handled sick marmot.
1956	Upper Cuyama Valley, Ventura County	Man visited site of ground squirrel epizootic.
1959	Yosemite Park, Mariposa County	Boy camped where a ground squirrel and chipmunk epizootic apparently had occurred.
1959	Sonora, Tuolumne County	Evidence of ground squirrel epizootic behind residence.

[1] Courtesy of K. F. Murray, State of California, Dept. of Pub. Health, Bur. of Vector Control.

TABLE 2.—Human cases of selected zoonoses reported in California, 1951-1961[1]

Disease	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	Total
Western equine virus	22	375	14	22	6	14	3	37	2	1	2	498
Relapsing fever, tick-borne	3	4	5	2	3	....	3	2	3	6	8	39
Rocky Mountain spotted fever	3	2	1	1	5	4	....	....	3	2	0	21
Tularemia	11	8	16	12	7	5	2	6	4	3	3	77
Typhus fever (endemic)	12	4	10	3	4	4	10	4	4	2	1	58
Colorado tick fever	.....	.....	No data	.....	.....	.....	4	17	2	7	7	37

[1] Source: State of California, Department of Public Health, Morbidity Records.

"Control measures were initiated at the Firebaugh and Mendota disposal sites. At Firebaugh this consisted of a temporary clean-up of the disposal site and the simultaneous use of warfarin in bait boxes. By April 1957 no rats were trapped at this site and none were taken until March 1958 when one rat was captured. This disposal site has since become reinfested with *Rattus norvegicus* but no further recoveries of *Xenopsylla cheopis* have been recorded.

"No control measures were instituted at the Mendota disposal sit until early in 1958. At this time the trench-and-cover method of refuse disposal was initiated, replacing the former open trench operation. A rodent survey just prior to this changeover found a heavy infestation of Norway rats still present and an average of seven *X. cheopis* per rat. Subsequent surveys showed an absence of rats and no recoveries of *X. cheopis.*" (J. E. Brooks, personal communication).

TABLE 3.—Captures of *Rattus norvegicus* in westside dump sites, Fresno County[1]

Localities and dates	*Trap nights*	*Number of rats*	*Rats per trap night*
Mendota			
1956	96	17	.17
1957	120	55	.45
1958	75	0	.00
Firebaugh			
1956	120	59	.49
1957	96	0	.00
1958	50	9	.18
Dos Palos			
1956	24	10	.42
1957	48	19	.40
1958	50	13	.26
Tranquility			
1956	96	36	.37
1957	96	29	.30
1961	48	17	.35
San Joaquin			
1956	48	19	.40
1957	48	13	.27
1958	24	11	.46
1961	24	16	.66

[1]Source: State of California, Department of Public Health, Bureau of Vector Control.

The report of Beck and co-workers (1950) on typhus fever in California also points to the prevalence of rats. Surveys conducted in 16 counties showed that of 1,718 rodents trapped, 1,126 were *R. norvegicus*, 280 were *R. rattus* ssp., 176 were *Mus musculus*, and the remainder was made up of various ground squirrels, woodrats, field mice, and other wild rodents.

The annual report for 1957 of the Pasadena Health Department indicates that during that year 1,076 requests were received for various types of environmental health services. It is of interest to note that rodent complaints constituted 41.5% and mosquito complaints were 2.7% of all requests for services received.

When one looks critically at the rat population of a large metropolis like San Francisco, the words of Hans Zinsser (1960) come to mind: "Man and the rat will always be pitted against each other as implacable enemies." Figure 2 indicates, in a general way, the trend in the San Francisco rat population. Over 50 thousand rats were trapped in a 10-year period: about 90% were *R. norvegicus* and the remainder *R. rattus* ssp. Although the number of rats taken in 1960 was about 25% of the total taken a decade earlier, the number of infested premises showed no substantial decline.

There would be little point in continuing to multiply these random examples. Many of you are in a position to cite much better data, and I know that examples of successful rodent control can be pointed out by workers in county and other local health agencies. Nevertheless, at this juncture, I would like to comment briefly on certain aspects of the rat situation in California. Fortunately, Mr. Joe Brooks of the Bureau of Vector Control has very kindly allowed me to present some of his observations. He has prepared a map that shows the distribution of Norway rats in California, based on currently available records. The largest concentrations occur in the Sacramento Valley and along coastal areas. Mr. Brooks evaluates the situation in the rice-growing regions in the following account:

"Rice is one of the important field crops grown in California. Rice acreage in this state grew to over 450,000 acres in 1954, but in recent years acreage allotments were imposed and the area involved currently is approximately 300,000 acres. Most of this rice culture occurs in the central Sacramento Valley counties of Glenn, Colusa, Yolo and Sutter.

"Norway rats occur in high densities in and around these ricefields. That they cause a considerable economic loss is not doubted, but the actual extent or estimated damage is not known or documented. They, along with muskrats and crayfish, damage checks with their burrows and certainly consume some portion of the maturing rice.

"Here is a case where a mosquito abatement district could step in and undertake a vertebrate pest control program in conjunction with its mosquito control work. The economic loss caused by these animals could be documented to show justification for a program of this sort.

"Of passing interest is the hypothesis that probably a good percentage of the Norway rats and muskrats are carrying leptospires. However, due to the extreme mechanization of the rice industry, leptospirosis is not a human occupational disease in this area. The idea is worth investigating, nevertheless."

Another map prepared by Mr. Brooks illustrates the currently known distribution of the subspecies (or varieties) of *R. rattus* in California. In general, the distribution is somewhat similar to that of the Norway rat except that the pattern shows a tendency toward invasion of certain suburban type residential areas. In a personal communication Mr. Brooks has a few remarks of interest on this matter.

"Recently we have witnessed an emerging pattern of roof rat infestation that is common to communities from Pasadena to Sacramento. This is the movement of the roof rat into the better residential areas of cities such as Pasadena, Bakersfield, Fresno, Stockton and Sacramento.

"These better residential areas are characterized by two types of neighborhoods: the older, well-kept homes with numerous trees and ornamental shrubs, often so thickly-growing as to suggest a jungle habitat; or the newer suburban, ranch-type development, often set amidst a former orchard. Both are best described as having numerous trees, many of them fruit or nut trees, and numerous ornamental shrubs and ivy. Palms do not occur in every area, but where they do they are well used for harborage and nesting sites by the rats.

"On warm summer evenings, residents of these areas are startled to see rats crossing their back-

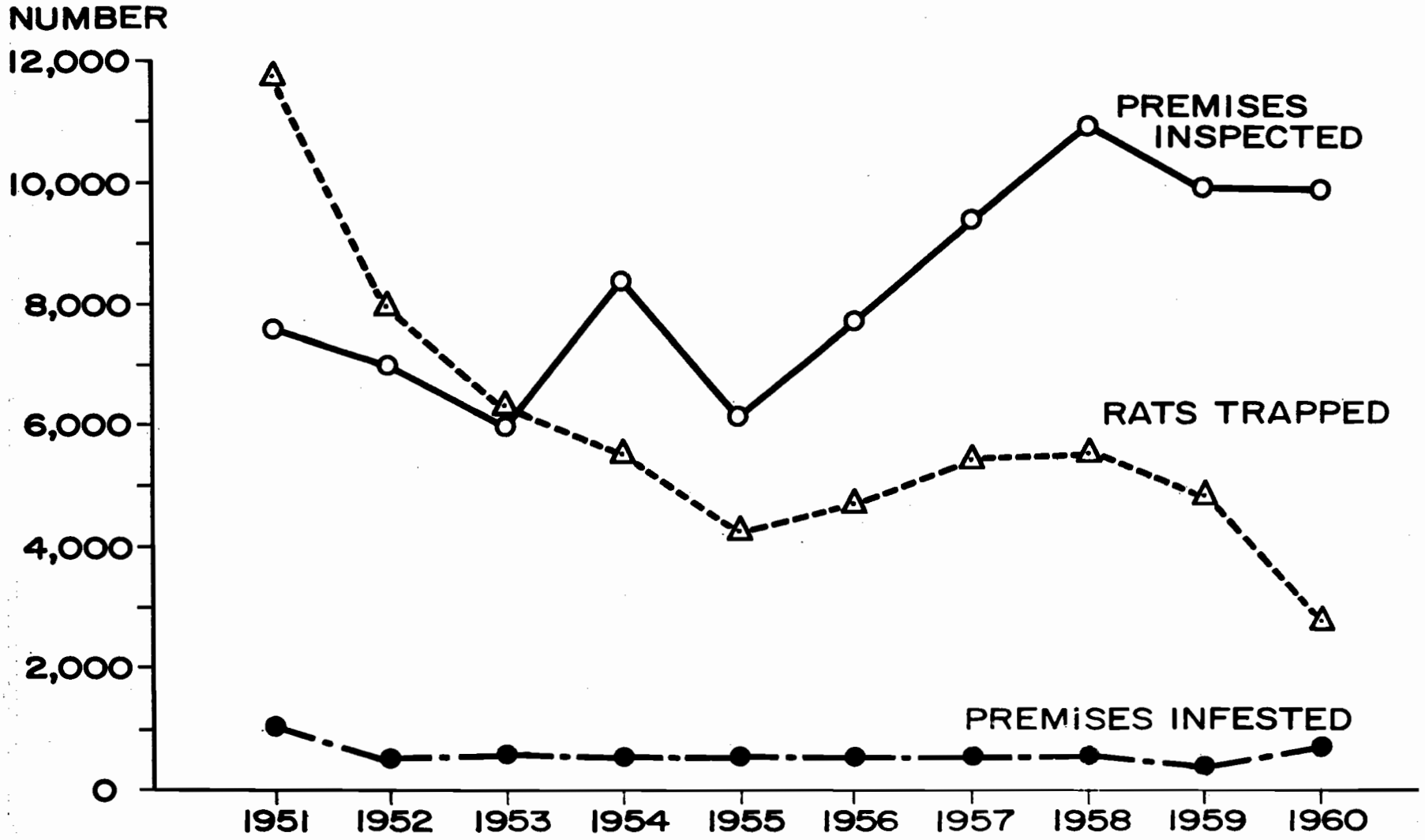

Figure 2. The prevalence of commensal rats in San Francisco over a 10-year period (furnished by courtesy of H. J. Stenson, San Francisco Department of Public Health).

yards on overhead wires or running along fences, or they are heard feeding in peach, apricot or walnut trees. The rats readily cross from the trees onto the roofs of the houses. Complaints are frequent from about July to October in these communities.

"A usual survey of these neighborhoods reveals that backyard sanitation is good to excellent except for stored materials in garages. Food appears to be adequate from natural sources, however, and harborage abounds in the numerous trees, shrubs and vines. Here the need for neighborhood harborage elimination is clear-cut."

This was precisely the pattern I observed in the foothill communities of Pasadena, Altadena, Sierra Madre, and Arcadia during 1958 in an evaluation of the murine typhus fever problem (Kartman 1958). At that time I stated as one of my conclusions that " . . . The environment associated with middle and higher socio-economic strata in the foothill communities is characterized by lush vegetative growth which is capable of maintaining commensal rodent populations no less efficiently than in slum, business, and industrial areas."

I am sure that some may feel that my emphasis on plague, and the rats and wild rodents associated with the disease, is merely the bias of one who is engaged in plague investigations and that the importance of this zoonosis has been exaggerated far beyond a rational frame. This may or may not be a valid criticism, but I would like to emphasize that I have used plague as a symbol of a public health rationale in which local agencies, concerned with the control of arthropod vectors, engage themselves in anti-rodent work even though the health implications appear rather tenuous. Some investigators seem to be dominated by a rather purist ecologic view; to them, the occurrence of so few human plague cases suggests that since man, like the rabbit and some other mammals, is an accidental host to the infection, there is little reason to become disturbed over an occasional victim since this is the result of an ecologic mechanism operating on a plane of extremely low probability. If I subscribed to this concept, I could not then, in good faith, be proposing a new emphasis on rodent abatement in connection with plague control or the control of any other rodent-borne disease of man that occurs at a very low frequency in California.

I must take the view that our ultimate aim is the prevention of even a single human case of plague. In a statistical context, a case of human plague may be to public health what a viable gene mutation is to biological evolution; that is, a highly improbable event. Nevertheless, there is a tremendous focus of interest on an unusual event, especially if it carries within it the potential for affecting the ecosystem. So it is in my view of plague, and of certain other rodent-reservoired infections; a single human case has the potential of unleashing a chain of effects, not only bio-medical, but also economic and psychological. On this basis I then assume it is quite logical to advocate that local health and vector control agencies should give more attention to the matter of rodent control as it may apply to their particular areas with their unique problems.

From the standpoint of disease potentials, other than plague, some of the problems would be related to the occurrence of infections such as tick-borne relapsing fever, Rocky Mountain spotted fever, tularemia, murine typhus, and Colorado tick fever. The records since 1951 show a total of 232 human cases of these diseases (Table 2). Tularemia cases are recorded from 22 counties, relapsing fever from 12 counties, Rocky Mountain spotted fever from 9 counties, and endemic typhus from 4 counties.

Beyond the bacterial and rickettsial infections involving rodents and their ectoparasites, the viral infectons probably are the most interesting and possibly are the most important. The so-called arthropod-borne virus diseases are dominated by the bird-mosquito epidemiologic concept. However, at your 28th annual conference, Dr. Harald N. Johnson (1960) presented evidence as a basis for suggesting that there is a need for a "long term study of small mammals and the role they may play in the ecology of the arthropod-borne viruses." As Dr. Reeves succinctly put it during the discussion, "Harald is on a rodent binge and I am on a bird binge." I am certainly happy that Dr. Johnson has become intoxicated with the virus-rodent concept, because it adds an authoritative beam to this spotlight on rodents.

According to Dr. Johnson (see Lennette *et al.* 1956) the virus of western equine encephalitis has been isolated from tree squirrels, *Sciurus griseus*; 11 positive animals were found from 1953 to 1962, 3 in Sonoma County, 2 each in Napa, Marin and Butte counties, and 1 each in Lake and Tuolumne counties. The California ground squirrel, *Citellus beecheyi*, also has been found infected with this virus on three occasions. Table 2 shows the incidence of western equine virus infection in humans. The 498 cases that occurred between 1951 and 1961 were distributed in 25 counties.

In 1958 Modoc virus was isolated from a deer mouse, *Peromyscus maniculatus*, in Modoc County. Also in 1960-61 there were 10 isolations made of Colorado tick fever virus from rodents in Modoc County. The virus was found in chipmunks, ground squirrels, a woodrat, and a pocket mouse (H. N. Johnson, unpublished).

Other viruses, such as Rio Bravo and Kern Canyon, have been found in bats in Kern County, and the former also in Sonoma. Thus, together with their well established epidemiological role in rabies, bats may be even more important as a source of viral infections than is now known, and could well be considered in a broad program of vector control.

Fluctuations and cycles of rodent populations are undoubtedly two of the numerous reasons why anyone would entertain ideas of rodent control. When "plagues" of mice occur, people become interested. At the same time, it is significant to public health that an increase in rodent population density may be an important factor influencing the transformation of infection to disease. Current hypotheses point to the effects of physiologic stress as the mechanism that may stimulate the change from asymptomatic infection to clinical disease in a "resistant" host during a sharp rise in the population. This is one of the main reasons why our laboratory studies the rise and fall of rodent communities like *Microtus* and *Peromyscus*. We would like to

Figure 3. A typical example of surface runs and burrow system openings of the vole, *Microtus montanus*, during the population irruption in northern California and other regions of the Pacific Northwest in 1957-1958.

be able to predict the onset of cyclic changes in rodent populations and to estimate in advance the approximate intensity of their peaks and troughs.

This type of information might be of some interest to those concerned with rodent abatement. Ecologists have been concerned with the problem for a long time and, in a rough way, predictions of population changes can be made for certain species. Nevertheless, it will take a long time before really accurate estimates can be made. Thus, in a way, these remarks expose the race between those who try to understand and those who want to eradicate. In this case, I would be happy to see rodent populations being liquidated in some regions of California even though I am a long way from understanding their ecology in relation to plague. In public health there can be no compromise—one must at times give up the desire to be well informed in favor of being well protected.

During the fall and winter of 1957 and the spring of 1958 a tremendous irruption of voles, *Microtus montanus*, occurred in northern California and generally throughout the Pacific Northwest. Particularly large outbreaks were noted in the Tulelake Basin and in the Bridgeport Valley of Mono County. The population estimates ranged from several hundred to as high as 3,000 voles per acre. In many fields the *Microtus* runs and burrow systems riddled almost every square foot of ground. A typical example is shown in Figure 3. Counts of open holes into underground burrow systems numbered as high as 28,000 per acre.

The competition for living space and food was intense. Everything edible was eaten, including fence posts. A large proportion of the voles died in the fields, presumably from the effects of stress and from various infections. Our investigations showed that many of the voles succumbed to tularemia and that the overall death rate from this disease in various areas ranged from 20 to 35%. In general, ectoparasite vectors were seldom involved in this epizootic. The overwhelming evidence indicated that tulameria transmission was due to cannibalism, especially in areas of high population density (Kartman *et al.* 1959).

The environment was found to be widely contaminated with tularemia organisms, *Pasteurella tularensis*. The bacteria were isolated from river water, domestic wells, irrigation ditches, ponds, mud, straw, and from *Microtus* nesting material in cultivated fields. From 8 to 10% of these various inert materials were found contaminated. No studies were made to determine whether tularemia infection in humans had occurred in California. However, just over the state line to the north, in Klamath County, Oregon, a total of 12 cases was found in 126 persons examined. Evidence linked these cases with the epizootic in the *Microtus*.

Two of the most important consequences of the vole irruption were the enthusiastic cooperation among a number of diverse agencies, and the appropriation of funds by the State of Oregon for a 10-year ecological study of *Microtus* populations in the Klamath Valley. The work has shown significant progress and the information being accumulated should soon be approaching the stage that will allow predictions to be made. This will provide for better planning of control operations when they are in prospect.

The subject of rodents is, of course, encyclopedic, and it would take nothing less than a monographic treatment to do justice to the situation even in very delimited regions of California. I think a major task at the present time is the evaluation of needs in the field of rodent abatement. We must find out what we do know and where our ignorance lies. We need to expose and analyze the problems peculiar to each locality. We need to think of rodent problems in terms of epidemiology; that is, to evaluate the significance of rodent activity not only when its presence is obvious, but also when quiescent periods occur and nobody complains about rodents or rodent-borne disease. In the long view, we must give close attention to possible effects on rodents of changes in the ecosystem that may be caused by extension of irrigated areas, changing agricultural practices in crops and machinery, the use of new insecticides and herbicides, and by the encroachment of our rapidly expanding population into the nonagricultural hinterland where wild rodents and their ectoparasites and infections reside.

This actually is a broad inter-agency issue, and it is only by a thoroughgoing cooperative and coordinated program that it will be possible to gather the factual information necessary for an intelligent view of needs in rodent control. Possibly, at present, the problem of communication between agencies, as much as between individuals, looms as the immediate hurdle to be overcome. During the *Microtus* irruption in 1957-1958, close communication was established among agricultural, wildlife, game, public health, and other agencies on all governmental levels. Regular information bulletins were issued through the Oregon State Board of Health, and after termination of the work a joint publication was issued in which most of the participating organizations had sections devoted to their special findings.

Once lines of communication are established among interested agencies and organizations, it would seem that the next stop would be to centralize the gathering of information and the arranging of a medium or a channel for its dissemination to all cooperating parties. The Bureau of Vector Control, of the California State Department of Public Health, could possibly serve as a repository for digesting and synthesizing data regarding rodent populations and related disease, ectoparasite, and control problems. It also appears logical that the California Vertebrate Pest Control Technical Committee should take an active role in this work. Perhaps, also, the next Vertebrate Pest Control Conference could receive support from various vector control and other local agencies interested in a broad program of reducing to a minimum the threat to the public's welfare, whether from insects, ticks, mites, rodents, birds, snakes, or other noxious creatures.

California, the most populous state, does not lack for knowledge or know-how. We have the experts, the people with the experience, and those who are eager to do things. Once they begin to pool their information and to coordinate their efforts, nothing should be able to stand in the way of ultimate freedom from animal pest populations and the diseases and annoyance they cause.

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THE EDUCATIONAL APPROACH TO VECTOR CONTROL IN SANTA CLARA COUNTY

JAMES ST. GERMAINE

Santa Clara County Health Department

For most of its history, Santa Clara County has been an agricultural community. In fact, it has only been since World War II that this picture has changed. As in many other California communities, population increases have been astronomical, and industrial development has kept pace as a matter of course. At this time, the population is increasing at a rate of more than 4,400 persons each month. There are 15 incorporated cities in Santa Clara County, many of which have been in existence for only 2 or 3 years. All of them appear to be expanding their borders as rapidly as possible through the annexation of peripheral unincorporated lands.

For the purpose of our discussion here today, I should like to divide a portion of northern Santa Clara County into three general classifications. We can call them urban, suburban, and rural. Let's discuss each of these in turn.

Urban—In this area we find almost all available and suitable land completely developed, with commercial and residential construction predominating. The types of vector problems most likely to be encountered here are for the most part minor when viewed individually; the most common exception to this is rodents, which in some urban areas is a serious problem.

Suburban—The suburban area in our county is characterized by rapid change, expansion, and often mixed interests. For the most part the major development is residential, with subdivisions springing up along the periphery of the urban area and reaching into the rural area. Here the normal or routine vector problems co-exist with the major problems, those frequently found in association with both dirt and livestock farming. This is the area which requires maximum effort on the part of health department personnel. Here is where the vector control specialist must bring into full play all of his intellectual resources. Here is where we find the thousand-home subdivision immediately adjacent to the dairy, the hog ranch, and the poultry farm. In one corner then we have for example, the highly irate and extremely vocal ladies of Oak View Park, and in the opposing corner the livestock farmer protesting, "I was here first;" in between we find that sometimes puny referee, the health department representative.

Rural—In the rural area the principal developments are, as one would expect, agricultural. The residents are usually people who like to live in the country and are prepared to accept some of its discomforts, or by persons who are directly connected with agriculture. In Santa Clara County a large amount of this area is protected from wildcat annexation encroachment through the use of "Greenbelt Zoning." This then, is the area where change is expected, but is not generally considered to be imminent.

It is in communities such as the one I represent, that the need for individual specialization in some phases of public health work becomes apparent. Out of this apparent need for specialization has evolved the occupational health technician, the health educator, the public health veterinarian, the air pollution control expert, and the vector control specialist, to name but a few.

In 1953, under the direction of the Health Officer, Dr. W. Elwyn Turner, a vector control program was initiated through the Santa Clara County Health Department. Since the first specialist was hired, the staff

has increased to 16 full time positions, plus 4 or 5 part time staff assistants who are used in the critical summer months when work loads approach their peak.

General Approach to Vector Problems

Although each vector must be considered separately, there are some general principles of control that apply to all.

The first step in working out a solution to a specific problem is to ascertain the facts as to the source of the flies, mosquitoes or rodents as the case may be. This requires very careful investigation and surveying of all the actual and potential vector sources in a given area. Whenever possible, surveys should be conducted on an organized and systematic basis, in order eventually to cover the entire county as a foundation for a preventive program.

The second step is to determine responsibility for the production of the particular vector species.

The third step is to inform everyone concerned, both with the facts regarding the infestation and the procedure proposed for solving the problem. This should include the basic facts of the life history and habits of the vectors, the complexity and extent of the problem, and the various techniques that might be used in reducing or eliminating the vector sources.

The fourth step is to help alleviate the immediate condition through application of temporary control measures, at the same time working out a more permanent solution with the person responsible.

As a last resort, abatement proceedings may be used to eliminate vector sources in cases where offers of assistance and cooperation have been refused, when all reasonable means of education and of persuasion have failed, and when the public's interest will be served.

The Educational Approach

It is obvious from the size and complexity of vector problems in our county that it would be impractical to conduct the kind of large-scale operational program necessary to control all vector and nuisance species. It is equally apparent that any practical solution depends for its success on the cooperation of an informed public. This necessitates a carefully planned educational approach to all local vector control problems. This aspect of our program is greatly implemented by the availability of a graphic artist on the staff and through the efforts of an aggressive, intelligent health education division.

To guide our educational program, certain policies were formulated at the very beginning of vector control operations in Santa Clara County. The most important of these states that: "Primary emphasis will be placed on the progressive reduction and elimination of vector sources through education, persuasion, and cooperation." Such a policy can be converted to an action program only when every member of the staff accepts it fully. The office secretary has a vital role in this program, as she deals with telephoned requests for assistance on vector problems. The vector control operator has perhaps the most important educative function of all, since he is constantly meeting people and problems in the field. The vector control specialists most frequently are working with groups, as well as with individuals, through formal talks and informal discussions.

Our educational program consists of three phases. First is the in-service training of staff, both for general technical competency and for specific responsibilities as members of an educational team. Second is the direct educative function of the staff in its on-the-job contact with the public. Third is the mass education approach of the staff as a whole, through addresses to civic groups, assistance to the schools (public and private), preparation of exhibits, and the use of timely news releases and feature articles in the newspapers designed to acquaint the public with the facts about vectors and give them the necessary information to help themselves.

Educational Materials

An important part of the program is the development of well selected educational materials and the training of the staff in their proper use. We have the following types of materials available which have proven particularly valuable:

Living organisms in the field—The vector control specialist who shows a housewife a crop of maggots in her garbage can has used the most effective educational approach possible, and has employed the best teaching material to make his point. The housewife rarely needs a repeat lesson in "fly biology!"

Prepared mounts of life cycles and pinned insects—Properly displayed in glass tubes, fly and mosquito life cycles are excellent supplements to living materials. (Used procaine tubes salvaged from dental offices make good display mounts.)

Illustrated notebooks—Loose-leaf binders displaying 8″ x 10″ photographs of both good and bad management practices can be extremely helpful to the vector control worker. Such photographs implement our defined departmental program, suggesting ways in which a vector problem can be solved. The vector control specialist thus becomes an advisor rather than a policeman, and emphasis is shifted from compulsion to cooperation.

Posters and display mounts—Large photograhs appropriately mounted have eye appeal and dramatic impact that is of great value to a speaker seeking to influence either large or small groups. Speakers from the Santa Clara County Health Department can draw upon more than 100, 20″ x 24″ display photographs to illustrate local vector control problems and to demonstrate recommended methods of solution. These large pictures have the particular advantage of stimulating discussions among persons present at such meetings. Since they can remain on display after the speaker is finished, they can be a continuing source of reference and illustration.

Slides—Colored slides are highly effective to supplement display mounts. They are best used to highlight and amplify major ideas developed. Slides are also prepared of pictures available as display mounts, to be

used where desirable for reasons of speed or centralized control, or for very large audiences.

Motion pictures—Two kinds of films are used effectively in Santa Clara County. Such commercially prepared films as Walt Disney's "Insects as Carriers of Disease" and "The Winged Scourge" are highly useful. In addition, we have two motion pictures on local vector problems which were developed by our staff.

Teaching units for use in local schools—In cooperation with the Santa Clara County School Department and San Jose State College, a self-contained teaching unit on vector control problems was developed for use in local grammar school classrooms. This program of teaching unit development is sufficiently novel to merit special discussion. Its great potential value stems from the mutual advantage it possesses for all agencies concerned. Vector control benefits tremendously from wide dispersal of pertinent information on local problems. The schools gain practical teaching materials relating to real and significant local problems, and these materials are prepared for maximum teacher convenience.

[Editor's note: At this point Mr. St. Germaine demonstrated a variety of unique visual aids developed by the Santa Clara County Health Department.]

Pamphlets—These valuable aids developed and illustrated by our staff are used extensively during surveys of residential areas. They are written very simply in order to reach a large section of the reading public.

Micoscope slides—Though limited in use, microscope slides are of value when working with small groups, particularly when these groups include persons with some background in the biological sciences. Approximately 450 slide mounts of various arthropods have been prepared by our staff for educational purposes.

Flip charts—These easy to use visual aids, cheerfully illustrated and simply written, are designed specifically for use with small, informal groups. They are, for example, used very frequently in our Boy Scout merit badge programs.

Flannel boards—Several types and sizes of flannel boards are used, depending (to a large extent) on the size of the audience and the subject to be discussed. One, a commercially prepared board, is used very successfully in teaching simple morphology and taxonomy to grammar school children.

Plastic molds—Preserved insects mounted in unbreakable molds can be safely handled and passed through an audience during a lecture. When the plastic mold becomes marred, simple polishing will restore it to its original condition.

Thus you have, ladies and gentlemen, a brief synopsis of the program developed by the Santa Clara County Health Department to promote better public health through the educational approach.

GNAT CONTROL IN MOSQUITO ABATEMENT AGENCIES

WILLIAM E. HAZELTINE
Lake County Mosquito Abatement District

Having prepared this paper for presentation before the preliminary programs came out, I was a little unnerved to find a title limiting this discussion to the Clear Lake gnat. I enjoy talking about our program, but the broader scope implied by the final program title is much more appropriate. Not every district has a gnat problem, but many areas have problems with one or more different kinds of gnats, so I will be talking about the general picture of gnats, and how we stand on ways to control them. I will attempt to give you a summary of information which I have gathered from various people and sources where gnat control information is available.

There are four major kinds of gnat problems in California, and we should review these to be sure we are all thinking about the same things. One is the *Hippelates*, or eye gnat group, and these are characteristically found in warmer areas in lighter type soils. Dr. Mir Mulla has addressed this Association and shown kodachromes of the date garden areas and elsewhere in southern California areas where this gnat is a problem. A second group of gnats includes the chironomids; these are characteristically associated with small lakes, sewage ponds, and often temporary bodies of water. A third group is the genus *Leptoconops*, or "no-see-ums," and Donald Grant and his staff have addressed the Association on the excellent research progress they have made with this group over the past several years. These gnats are associated with particular soil types which have a tendency to crack deeply. The fourth group of gnats is the chaoborids, of which the Clear Lake gnat is the predominant pest. This gnat tends to reproduce in excessive numbers in permanent bodies of water which are biologically rich.

Perhaps the best approach to our present consideration of these problems is to ask two questions. The first of these is: Why consider gnat control in a mosquito abatement or pest control district? The second question is: What can be done about control, if gnats are present? It is the answers to these questions which delimit this discussion.

The reasons why gnats have not been included in abatement district programs in the past can be categorized under several headings: (1) no problem exists; (2) the problem is masked by other pest insects; (3) there is a lack of technology concerning control; (4) the costs of control are prohibitive; or (5) for traditional reasons.

The attitude of the general public has changed in the last few years regarding the insect pests which they will tolerate, or the numbers of any particular pest which they will tolerate. This changing attitude now often demands that something be done to control a gnat species which in the past had been considered only a nuisance to be tolerated.

Abatement districts are the logical choice of agencies to undertake gnat control. Abatement agencies have

the facilities to apply controls, and by assuming these responsibilities the tax-paying public is relieved from the expense of establishing a separate agency to cope with these problems. In addition, as a result of recent research we can draw upon an improving technology. The decision to take on one or more of these additional problems is, of course, a matter of individual consideration by each district.

Of the several reasons listed for agencies not undertaking gnat control, two can be disposed of in short order. If no gnat problem exists there is no reason for control; in such circumstances your agency should consider itself lucky. If a problem is present but masked by a more conspicuous pest, your success in controlling the top priority insect will gradually bring gnats into focus and their pest status will become clearly apparent. An example of this would be heavy mosquito breeding in an area, which limits public use at the times when a gnat pest is active. If you control the mosquitoes so the area can be used, the gnats will then become a problem.

Reduced costs of control and an improving technology go hand in hand, and progress is being made with both. As research is done, more efficient materials and methods of controlling gnats are being found, and agencies which have thus far declined to participate in a gnat control program should perhaps re-evaluate their position to consider whether presently available technical information might not indicate a change in policy.

We are now ready to consider the role of research, how information on control can best be obtained, and, briefly, what is being done in these areas of investigation. The purpose here is to consider the highlights without undue attention to the many important but tedious details. Actually, specifics would be meaningless in many cases, and possibly misleading. Details can best be obtained from the research personnel immediately concerned with a particular problem. All of us in these research programs are happy to share the latest information on control of the gnats we are studying.

The *Hippelates* eye gnat and the chironomid gnats are under intensive investigation by workers at the University of California at Riverside. Dr. Mir Mulla is engaged in chemical and physical control research, and Drs. Ernest Bay and Fred Legner are concentrating on biological control research on *Hippelates*. Dr. Lauren Anderson and associates are conducting extensive chronomid gnat investigations. *Leptoconops* gnat research is being undertaken through the San Mateo Mosquito Abatement District by Donald Grant and his staff. Chaoborid control research is being intensively pursued by the Lake County Mosquito Abatement District, with Dr. Sherburne (Jerry) Cook the Research Director for this program. What might appear to be provincial research on the latter two species of gnats by mosquito abatement districts, is in reality a cooperatively financed program. State subsidies have been made available on a matching basis to these districts because it has been recognized that research done in one geographic area can be applied to other areas, and neither of these gnats is a respector of district boundaries. This Association has been a major contributor to all these programs through its repeated support of budgetary requests in the State Legislature.

After reviewing the types of research being done on these four groups of gnats, a striking similarity in approach is apparent—that is the emphasis on research toward non-chemical means of control. In each of these research projects the biological and cultural control methods are receiving increased attention. The reasons for this shift in research emphasis appear almost obvious upon analysis. Chemical controls are usually costly, and temporary at best. We are constantly faced with the problem of insecticide resistance. The consequences to wildlife and even to certain plants from chemical applications are often sufficient to preclude the use of these effective materials. When successful, biological control usually affords more lasting results. This is not to infer that the chemical approach to control is being neglected; it means that current research efforts are aimed at utilizing every available tool to effect a control of these pests. It is often necessary to integrate a chemical, biological and physical approach, using each to its best advantage in a total program. This is exactly what we do in mosquito control when we undertake physical control by drainage, biological control with *Gambusia*, and apply chemicals against those that remain.

To be more specific about the gnat research programs, we should consider each group individually. Dr. Mulla has addressed this group concerning the control of the *Hippelates* eye gnat. He has reported a resistance of these insects to DDT, and has reported the results obtained with cultural control methods. By proper use of herbicides and cultural practices he has obtained some excellent results in the southern California area. In a recent article Dr. Ernest Bay reported on some parasites reared from the *Hippelates* gnats, and research for effective means of biological control of this pest species is continuing. A paper on this subject is scheduled for tomorrow afternoon.

The work of Drs. Anderson and Bay on chironomids in southern California, complemented by the research of Dr. William Hilsenhoff in Wisconsin, has indicated the apparent limitations of chemical control methods for this group of gnats. For various reasons, chemicals have not appeared to be the answer for control in many problem areas. Dr. Bay's work shows good control in some areas by manipulation of large populations of carp. In discussing chironomid research with Dr. Bay, it is my understanding that his associate, Dr. Legner, will be looking abroad for fish species which might be more effective for controlling chironomids and other aquatic gnats. With the urban sprawl associated with our increasing population in California, the extensive new flood control and irrigation water impoundments, and the demands of sport fishermen for elimination of carp and other rough fish, chironomid gnats are inevitably an increasing threat to many areas.

Donald Grant and co-workers at San Mateo have found cultural control methods for *Leptoconops* to be

more practical in most cases than chemical control. Some of the more apparent approaches to cultural control are to change the soil moitsure and other environmental conditions in the soil cracks at a critical time in the gnat life cycle, or to change the plant cover so that the soil cracking patterns are changed. The types of soil which will produce *Leptoconops* gnats are apparently marginal for agricultural production, but will apparently "grow" houses without much difficulty. For reasons of population pressure and economics it is possible that many districts are coming closer and closer to the necessity of doing something about *Leptoconops* control.

Returning to the Clear Lake gnat, we were able to field test a new approach to chemical control last year. Although the results of this effort were gratifying, we are agreed that chemicals alone are not the answer. With relief obtained, our emphasis has shifted even more to the biological program. Dr. Cook's research on fish predators has been the principal focal point of biological control investigations thus far; however, we hope to expand the research program to cover additional fields. If State financial assistance is continued, we plan to undertake pathological studies in addition to the present work on predators.

As with all control programs, there is never enough information about the biology of the pest to be controlled. We hope to give more emphasis to a study of the ecology of the Clear Lake gnat to find weak links in the chain that can be attacked by chemical, biological, or physical means or a combination of these.

Lest anyone sit back complacently, thinking that this is just an unfortunate problem for Lake County, I should point out that the Clear Lake gnat is already a problem in a lake in Redding, and Joe Willis is planning to control it. It is also a chronic problem in two lakes in Santa Cruz County. With the California water plan scheduled ultimately to move Eel River water to Imperial County through naturally infested lakes, this gnat could become a problem for many districts.

Any consideration of gnat research would not be complete without recognizing the support of the various groups in the Department of Public Health. The research personnel of the Fresno laboratories deserve particular recognition. While I know of no extensive program on gnat research at this laboratory, their allied research and support of those of us actually doing a job, demands that they receive equal recognition. We have enjoyed a most cordial cooperative relationship with research personnel in the University, the Department of Fish and Game, in addition to the research and administrative personnel in the Department of Public Health.

From all of this discussion, it should be evident that something can be done about a gnat problem. A technology is available and improvements are being made constantly, so that information is available to anyone who desires to start or continue gnat control in his district.

NEEDS AND POTENTIALS FOR YELLOW JACKET CONTROL

C. Donald Grant
San Mateo County Mosquito Abatement District

It is a matter of record that envenomization by bees and wasps constitutes a serious problem for great numbers of individuals each year, and that collectively the fatalities resulting from such stings may exceed deaths from all other venomous forms in the United States. The number of people with hypersensitivity to vespid venom is significant, as is the number of seriously affected human victims of such stings that are recorded each year. Almost everyone is familiar with the tremendous nuisance and discomfort potentials afforded by yellow jacket populations over many portions of our state, wherever man enters their extensive domain.

Although populations of the various species tend to be cyclic over a period of years in regard to their relative abundance and nuisance potential, in recent years the several prevailing species have collectively elicited a strong demand, especially from recreational areas and outdoor eating sites, for control technology and application. Such requests, originating from many areas throughout California are due primarily to two or three species of yellow jackets whose increased populations may perhaps reflect more than a cyclic phenomenon.

In 1960 the Department of Recreation and Parks asked the University of California at Los Angeles to study the problem and, if possible, make control recommendations (Wagner 1961). The studies were carried out at Griffith Park area of Los Angeles where great discomfort and even danger were caused by yellow jackets *(Vespula pensylvanica)* and honey bees *(Apis mellifica)* in the zoo area as well as in picnic grounds. Similar problems and requests may be attributed to many recreational bodies in recent years, especially the last two years.

Visitors and working personnel in national parks and the Division of Forestry have encountered severe annoyance through such vespine populations and have been using various methods to alleviate the problem. In our coastal mountains, Boy Scout and Girl Scout camps and others have been so plagued by yellow jackets in late summer that some sessions have had to be cancelled.

Many of our counties in the coastal area whose population growth has rapidly expanded into natural terrain and the province of the yellow jackets, with either housing tracts or recreational facilities, have suffered a tremendous curtailment of outdoor activity in summer through unbearable annoyance and fear of such yellow jacket populations. In San Mateo County the majority of outdoor functions entailing the presence of food or beverages during late summer for the past two years have either been made miserable or cancelled due to these stinging pests. Members of riding groups have experienced severe attacks on horseback where riding trails are utilized by ground nesting species. Ground nests in school yards, residential backyards, and public grounds have repeatedly led to criti-

cal envenomization of children who stumble upon the nests and are unable to escape the hundreds or thousands of angry workers that pour out to sting the intruder. This year our county parks suffered an immense drop in visitors, which was principally attributed to high numbers of yellow jackets. Numerous country club, commercial enterprises and great numbers of residents have joined such interests in beseeching relief from this summertime threat to their health and comfort.

San Mateo County officials have become acutely aware of this problem and the Board of Supervisors has requested various agencies to aid in such control. Our District is cognizant of the need; but, as with most agencies, we had many questions as to the feasibility of providing an effective program in face of the many unknowns which overall yellow jacket control might demand. An initial investigational approach was authorized by the District Board. This resulted in a basic evaluation of trapping methods, attractant baits, and operational procedures for the purpose of establishing standards for experimental control. A considerable understanding of the biology and population potentials of the two ground nesting species in California has also been attained through publications and field experience, as will be summarized below.

Control Endeavors.—Although only a small percentage of work is ever reported or subject to publication, still a very considerable amount of control work has been directed against yellow jackets all over the country. Many different approaches have been utilized and many local successes have been achieved. One wonders why so many control agencies have doubts about the feasibility of undertaking a program of yellow jacket control, but an analysis of these many different efforts reveals some obvious problems in accepting such responsibility on a permanent basis for large areas.

In spite of all this trial control work and the many available references on yellow jackets, there is a dearth of comprehensive studies on a well organized, lasting, control program; there is a lack of detailed study on species habits which might affect various control procedures over a period of time; and there are almost no data on which to establish indices of population evaluation, procedural efficiency, or standardized methods on a comprehensive basis for an area-wide program. Manpower needs, equipment needs, and financial needs for a program entailing one or several different approaches are the most difficult to ascertain. This is even more difficult if put on a basis of determining efficiency levels through evaluation of yellow jacket populations and potentials.

Most control efforts have been directed at relieving local sources in a specific feeding habitat or type of problem through a single approach. These are especially prevalent in regard to use of residual insecticides around organic waste containers, use of numerous and various types of traps in high attractant areas, the dissemination of poison baits in local sites and methods of destroying the vespine nests after location. Collectively, these reported procedures are of some analytical value, but do not provide the answer in regard to predicting the ultimate success of a continued program on a county-wide status designed to meet the problems of many different interests and scattered populations.

District Approach.—It has become apparent to personnel of the Bureau of Vector Control and others that considerable basic evaluative study is needed before reliable prognostic data can be made available as a guide to an effective and cost efficient program of yellow jacket control. Toward this end the BVC has been undertaking certain initial evaluative studies. This last year the San Mateo County Mosquito Abatement District also undertook initial studies for the purpose of first establishing standardized methods of baiting, trapping, and basic operations before attempting to initiate experimental control or even population evaluation.

Knowledge concerning the species present, including their biology and ecology, is considered the primary requisite before starting any control study. Although much of the desired information has not yet been determined, the work of such people as Dr. Carl Duncan (1939) provides an excellent understanding of the biology and life cycles of the vespine group. Drs. Bohart and Bechtel (1957) of the University of California at Davis have provided a comprehensive key to California species of our social wasps, including members of the Polistinae and Polybiinae as well as the Vespinae. Thus far our field work has been directed toward only two species of *Vespula*, and an elementary summary of their biology and occurrence in San Mateo County is here given for the purpose of analyzing the control possibilities.

California Species (after Bohart and Bechtel 1957).—The yellow jackets and white-faced wasp or hornet belong to the genus *Vespula* with subgenera *Dolichovespula* and *Vespula* being separately recognized. *V. (D.) arenaria* is widespread throughout the State, although this year (1962) it appears to be at a low point in its population cycle. *V. (D.) maculata*, commonly called the white-faced hornet or wasp, is prevalent in the Sierras and the northern Coast Range. Two other species of *Dolichovespula* are recorded, but are rare (one is an inquiline in *arenaria* nests). The two common species normally build arboreal nests, with *D. arenaria* frequently using human habitations as nesting sites.

The subgenus or genus *Vespula* is well represented in California with five or six species recorded for the State, four of which have a widespread distribution. *V. pensylvanica* and *vulgaris* were omnipresent in the San Francisco Bay area this past year as well as in much of the state. *V. sulphurea* is principally a mountain and coastal range species from the northern to southern borders of California, yet it is not as common as the preceding two species. *V. rufa atropilosa* is principally a montane northern California species, but is found in portions of the Sacramento Valley and the San Bernardino Mountains. *V. austriaca* is rare and found as an inquiline in the nests of *V. r. atropilosa*. These species of *Vespula* are essentially ground nesting forms.

Species and Life History in San Mateo County.—Normally, San Mateo County hosts three common species of true yellow jackets which build paper nests in the ground or suspended from trees or buildings. This year (1962) the arboreal form, *V. (D.) arenaria,* has been almost completely absent. In contrast, the other two species, both of which build nests in the ground, have enjoyed one of their peak population years, occurring in approximately equal numbers according to our survey area and trap collections. These species, *Vespula vulgaris* and *V. pensylvanica,* were readily attracted to various proteinaceous baits, which they carry to their nests to feed to their developing larvae. The adult forms do not eat the protein foods, but rather survive on a liquid carbohydrate diet (especially sugars), much of which is afforded by secretion from their larvae in the nest.

Since normally only the queens survive the winter to start new nests each spring as the weather warms, yellow jacket presence is not noted until at least the first brood of workers has emerged from the small new nests started by the queens. This is usually in late May or June, depending on spring temperatures. The nest area is excavated and new combs built by the workers, so that there is a rapid expansion in nest size and population during the summer. Although large numbers of workers die during the summer, a population peak normally occurs at the end of summer (September). By that time many stingless males are developed in the brood cells, as well as new queens for the next year's perpetuation.

Many nests, or colonies, are destroyed through disease, parasites, animals (racoons and skunks), and by mechanical catastrophies during the season, while the rest of them come to an end as a result of food shortage with the advent of cooler weather in the fall. Inadequate food supplies overtax the worker population in providing protein substances for the developing larvae and the workers must also spend more time in seeking carbohydrate foods for themselves. In an apparent response to a variety of interacting stimuli following the onset of cool weather, many nests are destroyed by the workers; they are known to kill the growing larvae, often devouring them (possibly for their sugar contents), and even tear up the paper combs. In any event it is very rare for a nest to continue in use a second year, although it does happen. Sometimes the older nests may contain more than one active queen.

Of the two predominant ground inhabiting species in this area, very little difference has been observed in their general habits. *V. vulgaris,* however, tends to nest more frequently in forested areas near streams, whereas *V. pensylvanica* commonly nests in the soil of open grassy fields; but these tendencies are not consistent. So far as observed, food preferences are approximately the same for the two species; they are both essentially scavengers and predators, the adults feeding on flower nectar and miscellaneous sugar sources. Both are problem species to man, although *V. pensylvanica* may appear more aggressive.

Occurrence and Prevalence.—A comprehensive mapping of the distribution of the different species within San Mateo County has not been undertaken, but significant populations of yellow jackets do occur in many years in all portions of the county with the exception of the bayside lowlands and along the ocean shoreline on the west. Heavily developed areas (cities) tend to have a minimal population of foraging adult vespids and almost no nests, although some suburban sections (especially older sections) may have large numbers of the aerial nesting species *(V. (D.) arenaria)* in given years. New suburban developments are frequently plagued by ground-nesting yellow jackets. Populations tend to be heavier in warm, protected areas near a water source; whereas windy, cold areas are less commonly frequented.

The relative abundance of different yellow jacket species varies greatly on multi-year cycles (usually three years or more), as is true for many insect species; but the precise explanation for these cycles has not yet been fully elucidated. Currently the ground nesting species appear to be at a peak of their prevalence cycle, whereas *V. (D.) arenaria,* the above-ground nesting species, appears to be at an extremely low point in its cycle.

It has been noted recently that in one area in Millbrae a grassy field lodged as many as ten ground nests per acre in early summer. It is probable that this heavy density does not occur extensively, but several nests have frequently been located in close proximity in several areas of the County. Much of our terrain is ideal for supporting such nests, providing the soil, water, and food in a manner typical of known nesting sites; quantitatively such areas constitute thousands of acres within yellow jacket flight range of populated sections. Flight range here is considered as up to 1-2 miles, although actual flights might be significantly farther. More study and evaluation is needed in this regard.

Average nests at the end of August may house many thousands of workers, with many thousands of brood cells providing a continually maturing crop of replacements. It has been estimated that much of San Mateo County provides a situation wherein any given point is within flight range of nearly a million yellow jackets, although the local population density probably tends to inhibit invasion or territorial expansion by significant numbers from the more remote nests. Removal of the local population (within ¼ mile) will probably only extend the foraging areas of those populations a little farther away. Determination of practical foraging ranges for the different species under such situations also needs further investigation.

Standard sampling traps used by this District, as adapted from BVC traps, caught up to 1,400 yellow jackets per trap per day in early September. Larger traps and bait quantities could increase this number significantly, but probably would not be economical on an area unit and cost basis. It becomes obvious that yellow jacket control over a significant area, employing trapping measures alone, would become an enormous task in terms of traps, bait, and manpower.

It is apparently possible, as one experience seemed to indicate, to trap so many individuals from one nest that the larvae starve, thereby ending the life of the nest. In this test, conducted in early July, continued

trapping near the nest entrance resulted in removing a high percentage of the workers of a relatively young colony. Even though it might be possible to place enough traps in a given area to exhaust the adult and newly emerging workers, the number of traps required and man-hours necessary to set, bait and maintain the traps would represent a rather high cost per acre for control.

Outlook on Control Possibilities.—Control through the application of residual sprays is hardly desirable as a significant part of an overall program for a variety of reasons. First, chemicals applied in this manner are generally inefficient and slow in destroying the constantly arriving or emerging adults. Wagner (1961) did demonstrate, however, that a thorough application of 0.75% DDVP performed well on garbage cans at Griffith Park. Second, broader spraying of insecticides would entail greater potential harm to wildlife and other posisble toxic hazards than could be justified. Finally, insecticidal spraying is a temporary and costly approach fraught with problems of scheduling, endless repetition, eventual resistance by the insects, and without hope for eventual solution of the problem. Yet in some cases it may be effectively employed.

The most practical method of specific control appears at this point to lie with the use of poisoned baits. In employing this technique, bait is placed so it is only accessible to yellow jackets. Thus, it is picked up and carried back to the nest where it is fed to large numbers of larvae. Death of a high percentage of larvae within the nest seems invariably to lead to the end of the nest: hence, this would not only tend to reduce the local yellow jacket population, if applied early in the season, but would also serve potentially to eliminate the production of mating forms which normally develop late in the season.

Another possible control measure which seems feasible but has not yet been tested, lies in providing proteinaceous foods which have been impregnated with one of the newly developed chemosterilants. Such substance carried back to the nest by workers in the latter part of the season and fed to developing males might readily lead to the production of only sterile mating males over a large area. Since the female, or queen, mates only once and is the only one to start new colonies in the following year, it would appear quite possible that the sterile males would prevent colony development the following year via a large percentage of infertile females.

A third practical procedure is an obvious one: the detection and direct destruction of the nests themselves throughout the season. Many of these are reported by the public and are easily and safely destroyed by proper methods. In many areas nests may also be located by attaching pieces of bright yarn or cotton to trapped adults and releasing them, whereon they may be traced back to the nest visually in their slow, impaired flight. In forested areas this would be difficult if the nest is some distance away.

It is our belief that effective control is feasible over a large area at a practical cost level by an agency prepared to utilize the many different control approaches in a carefully planned and well directed program, provided such a program is undertaken on a sustained basis over the years with proper personnel and public support. An essential part of such a program would entail adequate surveillance and evaluation on a continuing basis. This will provide information on the relative effectiveness of various control procedures based on comparative standards, and will create an awareness of the new problems in control methodology that will inevitably arise.

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REVIEW OF THE *TRIATOMA PROTRACTA* PROBLEM IN THE SIERRA NEVADA FOOTHILLS OF CALIFORNIA

EARL W. MORTENSEN and JOHN D. WALSH

California State Department of Public Health
Bureau of Vector Control, Fresno

Triatomine bugs are of importance in California because of man's sensitivity reaction to their bite. Various species of this group have been found naturally infected with the protozoan *Trypanosoma cruzi* Chagas, the etiologic agent of Chagas' disease (Wood 1950a); however, transmission to humans has not been reported in this state. Only two cases have been recorded from the United States, both from Texas.

Triatoma protracta (Uhler) is the most widespread and troublesome of the species of Triatominae in California, occurring predominantly in the Sierra foothills and Coast Range. Ryckman (1962) reports five subspecies of *T. protracta* of which only one, *T. protracta protracta*, is found in the state. *T. rubida uhleri* (Neiva) and *Paratriatoma hirsuta* Barber are restricted in this state to the Mojave and Colorado deserts.

Usinger (1944), Keh (1956), and Ryckman (1962) have reported in detail on the biology and behavior of *T. protracta*. Briefly stated, the life history of *T. protracta* is usually associated closely with the nests of woodrats (*Neotoma* spp.), where the eggs are deposited and the nymphal stages develop. Both nymphs and adults take blood from the woodrat. Feeding on man is considered an aberrant part of the life cycle. The reason for these occasional forays into human dwellings is not clearly understood.

The problem created by the bite of this insect has been documented by reports of scattered cases in many areas throughout California. Explorer-naturalist John Lembert made observations of persons bitten by *Triatoma* sp. in Yosemite Valley in the 1860's. His collections were later identified in 1894 as *T. protracta* (data obtained from the archives of Yosemite National

Park Museum.) Additional reports by Wood (1950b) gave more extensive evidence of the problem of *Triatoma* bites.

In recent years the number of people living in semi-rural mountain foothills has increased, providing more opportunity for contact between man, sylvatic rodents, and *Triatoma*. During the past several years increasing numbers of *Triatoma* bite referrals have been received by the Bureau of Vector Control from residents and local health departments in the Sierra Nevada foothills. The lagest number of such referrals appear to have emanated from Mariposa County. Because of the frequency of *T. protracta* bites and severe reactions among residents, the Mariposa County Health Department requested the Bureau of Vector Control to assess the public health importance of this problem.

A study was made by Walsh and Jones (1962) of individuals experiencing a reaction to the bite. The information was obtained by a questionnaire designed to collect data on symptomatology and various relevant environmental factors. One hundred ten case histories of *Triatoma* bites were obtained during 1961 from people living in Mariposa and Tuolumne Counties.

A summary of the findings reveals that most of the bites occurred from June through September. Almost all cases reported being bitten at night in bed. The bites of *T. protracta* produced a wide range of response in individuals, with two fairly distinct types of sensitivity reactions being noted. The first was a localized reaction at the site of the bite, accompanied by itching and the formation of a large wheal which usually disappeared within a week. The second was a systemic response to the foreign protein injected at the time of the bite. An analysis of the 110 case histories showed that 84% experienced one or more of the following systemic responses: severe itching of scalp, palms and soles; edema around the eyes, tongue, larynx and trachea; welts and rash spreading over all parts of the body; nausea, fainting and diarrhea.

The severity of the reaction depends on the sensitivity of the host. It is generally agreed that hypersensitivity to *Triatoma* bites can be acquired by repeated exposure. It appears significant that 92% of the reactors in this study had lived in the foothill area over five years.

The wide distribution of *T. protracta*, along with a lack of information on the flight habits, methods for trapping and measuring the population, and the possibility of other sylvatic animals serving as hosts, make the formulation of control measures very difficult. At the present time control is directed toward preventing the bugs from entering houses by screening and insect-tight construction, and using a residual insecticide in and around the premises. The most desirable long range approach to control would be an organized effort on an area-wide basis designed to suppress the insect in the habitat of the primary host. This might be possible through direct application of a residual insecticide in or near the nest of the host or indirectly by use of insecticide bait boxes. With the latter technique the host animal picks up insecticide on its body while feeding on the bait and transports the toxicant to the nest. The method has been used to control fleas associated with sylvan rodents (Barnes and Kartman 1960). Finally, there is the possibility that a long-term reduction of the parasites could be accomplished by area-wide control of the rodent-host population.

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THIRD SESSION

TUESDAY, JANUARY 29, 9:00 A.M.

ANNUAL BUSINESS MEETING

Presiding: JOHN H. BRAWLEY, *President*

Mr. Brawley: The business meeting of the California Mosquito Control Association is now in session. For the record, voting is limited to corporate membership with one vote from each corporate member. All members who are paid up for the year 1962 are eligible to vote. 1963 dues will not be delinquent until June 30.

I have asked the chairmen of the various committees to submit written reports giving whatever detail they think desirable, but in presenting their reports here they will be asked to give only a brief summary. We shall not take any formal action on these reports; they will simply be accepted as presented, except in those cases where some action is requested by the committee.

Don, are you prepared at this time to give us your Secretary-Treasurer's report?

Dr. Murray: The Secretary-Treasurer's report consists of the audit done by the Association auditor. This report is kept in the files of the CMCA and will be published in the Proceedings.

M. FREEDOM MEEKER
CERTIFIED PUBLIC ACCOUNTANTS
Chestnut and G Streets
Exeter, California

January 2, 1963

Board of Directors
California Mosquito Control Association, Inc.
1737 West Houston Avenue
Visalia, California

Gentlemen:

We have examined the balance sheet of the California Mosquito Control Association, Inc., as of December 31, 1962, and the related statement of surplus for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

Our report includes the following financial statements:

Exhibit A—Balance Sheet, December 31, 1962.

Exhibit B—Statement of Surplus, Year Ended December 31, 1962.

Schedule 1—Schedule of Expenditures with Budget Comparison, Year Ended December 31, 1962.

General activities revenues were $32.25 less than the budget estimate of $3,680.00, and conference activities revenues were $882.98 less than the budget estimate of $3,000.00. Schedule 1 shows the amounts by which the budget was under-expended. Available surplus derived from general activities decreased by $1,653.44, while that derived from conference activities increased by $654.14. Your efforts to balance the 1963 budget are to be commended. We recommend that each budget be in balance, so that projected expenditures and reserves combined do not exceed anticipated revenue and the beginning balance, combined.

OPINION

In our opinion, the accompanying balance sheet and statement of surplus present fairly the financial position of the California Mosquito Control Association, Inc., at December 31, 1962, and the results of its operations for the year then ended in conformity with generally accepted governmental accounting principles applied on a basis consistent with that of the preceding year.

Respectfully submitted,

M. Freedom Meeker
Certified Public Accountant

MFM:rs

CALIFORNIA MOSQUITO CONTROL ASSOCIATION, INC.
BALANCE SHEET
December 31, 1962

EXHIBIT A

ASSETS		
Petty Cash		$ 60.74
Cash in Security First National Bank, Visalia		4,309.82
Fixed Assets (Note 1)		173.01
Total Assets		$3,543.57
LIABILITIES AND SURPLUS		
Liabilities		-0-
Deferred Revenues (1963 Surplus)		156.00
Surplus Invested in Fixed Assets		173.01
Available Surplus (Exhibit B)		
Derived from general activities	$2,514.29	
Derived from conference activities	1,700.27	4,214.56
Total Liabilities and Surplus		$4,543.57

Note 1: The fixed assets consist of a tape recorder purchased in 1961.

CALIFORNIA MOSQUITO CONTROL ASSOCIATION, INC.
STATEMENT OF SURPLUS
Year Ended December 31, 1962

EXHIBIT B

	Budget Estimate	Derived From: General Activities	Derived From: Conference Activities
Balance Available, January 1, 1962		$4,167.73	$1,046.13
Add Revenues			
Corporate Member Contracts	$ 2,800.00	$2,995.00	----------
Associate Member Dues	25.00	18.00	----------
Sustaining Member Dues	300.00	425.00	----------
Sale of Publications	300.00	209.75	----------
Miscellaneous	255.00	-0-	----------
30th Conference Registrations	1,000.00	----------	$ 710.00
30th Conference Exhibits	250.00	----------	250.00
30th Conference, General	1,750.00	----------	1,157.02
Total Revenues	$ 6,680.00	$3,647.75	$2,117.02
Total Available	----------	$7,815.48	$3,163.15
Deduct Expenditures (Schedule 1)	----------	5,301.19	1,462.88
Balance Available, December 31, 1962	----------	$2,514.29	$1,700.27

CALIFORNIA MOSQUITO CONTROL ASSOCIATION, INC.
Schedule of Expenditures with Budget Comparison
Year Ended December 31, 1962

SCHEDULE 1

Classifications	Budget as Amended	Actual Expenditures	Underexpended
Administration			
Advertising	$ 108.00	$ 108.00	-0-
Communications	325.00	300.45	24.55
Office Supplies	600.00	600.00	-0-
Office of Secretary	200.00	124.12	75.88
Proceedings Publication (875 copies)	2,000.00	2,278.64	(278.64)
Committee Expenses	3,400.00	946.76	2,453.24
Auditor	100.00	102.00	(2.00)
Travel Expenses	833.72	841.22	(7.50)
Contingencies	150.00	-0-	150.00
Total Administration	$ 7,716.72	$5,301.19	$2,415.53
Capital Outlay (Office Equipment)	$ 17.00	$ -0-	$ 17.00
Total General Activities	$ 7,733.72	$5,301.19	$2,432.53
Conference			
General Expense	$ 3,000.00	$1,430.98	$1,569.02
Proceedings Recording (Note 1)	175.00	-0-	175.00
Proceedings Stenographic	250.00	-0-	250.00
Preliminary Expenses	100.00	31.90	68.10
Total Conference Activities	$ 3,525.00	$1,462.88	$2,062.12
Reserves			
Unappropriated Reserve	$ 1,466.28	$ -0-	$1,466.28
General Reserve	3,000.000	-0-	3,000.00
Total Reserves	$ 4,466.28	$ -0-	$4,466.28
Total Budget and Expenditures	$15,725.00	$6,764.07	$8,960.93

Note 1: The State Health Department performed the services of recording and transcribing the conference proceedings.

Pres. Brawley: Thank you, Don. That certainly was brief, and a very good report.

It seems to be traditional for an incoming president to give a rather formal address on his hopes, his ambitions and his dreams. Since the days of George Washington, presidents all the way from the popcorn vendors local to the President of the United States usually give a farewell speech in which they try to explain why they didn't do all the things they had planned to do. I am following the tradition, of course, and I have made mine short, having asked everyone else to do the same.

A CLOSE-UP VIEW OF THE C.M.C.A.

JOHN H. BRAWLEY, *President*
California Mosquito Control Association

What is the greatest problem facing our Association? As your president, during this past year, I have been afforded an opportunity to get a "close-up" view of the organization. This kind of close inspection has made it apparent to me that we are a typical segment of a free democratic society. We have our progressive element which is constantly frustrated because we do not move ahead faster. Our conservative group fears that unless we move slowly and cautiously we will surely rush headlong into disaster. These forces, together with all of the various opinions in between, provide sufficient balance to enable us to make calculated and orderly progress. As a result, this actually presents a relatively minor problem.

Like most groups we occasionally have a member who insists that everybody else is out of step. This type of problem dates back to the beginning of history; consequently, society as a whole has developed some very effective methods for dealing with situations of this kind. Like a garden in need of cultivation, this is not a serious problem if given constant attention.

Among our membership we have a great many dedicated and unselfish persons who place the general welfare of the Association and progress in mosquito control above personal gains and personal glory. Certainly this is not our problem.

Unfortunately we do have a small but apparently growing number who seem to be more concerned about what the Association can do for them than what they can do for the Association. In my judgment, fresh from the past year's experience, *this* is our greatest problem.

For the purpose of illustration, let us compare our Association with a joint savings account in a sound institution. If the wife keeps drawing money out of the account as fast as the husband can make deposits there will be no gains and no dividends. If this continues for very long he may very well become discouraged and decide to join her in the spending spree, in which case the end result is obvious. However, if both will concentrate on putting everything they can into the account they will never have to worry about whether or not they will get anything out of it. The dividends are assured. This same principle applies to our Association and our membership. It's your decision. What are you going to do about it?

REPORT OF THE PROGRAM COMMITTEE

During 1962 the Program Committee held eight meetings in preparation for the 1963 Conference in Santa Barbara. These were held jointly with the regular Board of Directors' meetings and with the meetings of the Ways and Means Committee.

At the first meeting, a theme for the conference was agreed upon and an outline was prepared for the three-day program. This went through several revisions until the final meeting at the Bureau of Vector Control office in Berkeley on January 15, at which time the remaining details for the program were completed.

The Chairman would like to thank his committee and all others who helped with the program, especially those who assisted by way of securing the many excellent speakers you will be hearing during the conference. The assistance of Richard F. Peters is particularly acknowledged, with thanks to the Bureau of Vector Control for printing the program.

John H. Brawley
Dean H. Ecke
Henry L. Messier
W. Donald Murray
Richard F. Peters
David E. Reed
J. D. Willis, Chairman

REPORT OF THE LEGISLATIVE COMMITTEE

The Legislative Committee met twice during 1962 as a Committee and once with the Board of Directors for advice and recommendations. Two legislative recommendations were made to the Board of Directors by the Legislative Committee, both of which were adopted.

The first legislation is that which amends Section 2206 of the Health and Safety Code exempting Mosquito Abatement Districts from the Districts' Investition Law of 1933. The second legislative recommendation involves authorization and procedures by which mosquito abatement districts and pest abatement districts may make changes of common boundaries by mutual agreement. The good offices of Assemblyman Carley V. Porter authorized the services of the State Legislative Counsel in preparation of these bills. Both bills have been prepared and have been introduced to the 1963 Session of the Legislature. Assemblyman Porter recommended in the interest of reducing routine work that the amendment of Section 2206 be changed to make this permanent rather than on a bi-annual basis since Section 2206 was amended at eleven consecutive sessions of the Legislature without opposition. He further stated that if there was any difficulty in obtaining passage of a permanent amendment he would introduce the regular bi-annual amendment later.

The Committee received a request from the Borrego Valley Mosquito Abatement District asking that it consider legislation allowing portions of districts to be withdrawn at the request of a board of trustees. After much discussion, it was recommended to the Board of Directors that this request be tabled with a proviso that a representative of the Committee meet with the Trustees of the Borrego Valley Mosquito Abatement District to explain the undesirability of such a recommendation. This meeting took place in December 1962, and it is felt that no further action will be forthcoming in this respect.

In conclusion, the Chairman wishes to thank the members of the Legislative Committee and other interested members of the Association for their excellent support and interest.

William Bollerud
L. R. Brumbaugh
William E. Hazeltine
G. Paul Jones
E. Chester Robinson
T. M. Sperbeck
Gardner C. McFarland, Chairman

Mr. McFarland: I should like at this time to ask the

membership present to pass a resolution recommending permanent exemption from the District Investigations Act. Assemblyman Porter asked that we furnish such a resolution giving the reasons why we support this permanent exemption. I therefore move that the Association furnish a letter to Assemblyman Porter including the following reasons why permanent exemption is desirable: (1) it would eliminate unnecessary repetitive work on the part of the Legislature every two years; (2) this is noncontroversial, as evidenced by its being passed every two years for at least the last 11 Legislative sessions. (Editor's note: The motion was seconded by Lester R. Brumbaugh and carried unanimously.)

REPORT OF THE WAYS AND MEANS COMMITTEE

During 1962 the Committee had six meetings. Most of these meetings were held in conjunction with regular Board of Directors' meetings.

During the year the Committee sent out two questionnaires to members.

The first questionnaire asked the following questions:

1. Do you wish to change the Bylaws to allow individual memberships to vote and hold offices?
2. Is the present name, "California Mosquito Control Association," appropriate? Is the name "California Vector Control Association," more appropriate? If not, what are your suggestions?
3. Do you feel that the California Mosquito Control Association could do more for your district than it is doing now? If yes, in what way?
4. Should this Committee prepare proposals on how the expenses of a full-time executive secretary could be met and what advantages this person would provide for the organization?

The returns were very good, with 38 agencies responding.

On the first three questions the majority recommended that there be no changes; therefore, these specific questions were tabled, receiving no further action this year.

On question No. 4, the majority asked that the possibility of retaining a paid executive secretary be investigated. A subcommittee was formed to study ways of financing a paid secretary. Their findings indicated that the Association could not support such a person at present.

The possibility of hiring a clerical person to assist the C.M.C.A. Secretary-Treasurer has also been studied. It is the recommendation of the Ways and Means Committee that the Board of Directors make every effort to increase revenue so that a stenographer can be made available to the C.M.C.A. Secretary-Treasurer.

The second questionnaire asked:

Is your district in favor of requesting the C.M.C.A. Board of Directors to take steps necessary to secure state financial help for districts which have assessed themselves to the maximum and still are in need of additional funds to carry on an effective mosquito control program? Responses were received from 33 districts. Twenty-two were in favor of subvention and eleven were opposed to the subvention proposal.

There was considerable discussion of the results of this questionnaire at the Ways and Means Committee meeting on October 16. Realizing that the majority favored subvention, there was still a feeling among those present that while many of the districts do not object to it they would not help in securing such financial aid. Because of the problems of securing existing surveillance subvention, there was a feeling that any attempt to secure more funds might result in losing the present support. It was agreed, therefore, that this question should be tabled for the present.

Another point of consideration was the suggestion that the Ways and Means Committee devise a "code of ethics" for mosquito abatement agencies. This had been carried over from the previous year, and it did not receive much attention this year until the final committee meeting in Santa Barbara on December 6, at which time it was discussed at length. As a result of this discussion, the Committee voted to change the "code of ethics" to a "proclamation of principles". Further progress on this must be left to next year's committee.

The Chairman wishes to thank all who served on or assisted the Ways and Means Committee this past year, and it is hoped that some progress has been made in the interest of the Association during 1962.

Lester R. Brumbaugh	Melvin L. Oldham
Howard R. Greenfield	E. Chester Robinson
William E. Hazeltine	James St. Germaine
G. Paul Jones	Kenneth G. Whitesell
Henry L. Messier	J.D. Willis, Chairman

REPORT OF THE BYLAWS COMMITTEE

The principal assignment of the Bylaws Committee was to make a thorough study of the possibility and desirability of allowing all classes of membership to vote.

After analyzing the responses to questionnaires sent to the membership by the Ways and Means Committee it was determined that the Bylaws of the Association should not be changed at the present time; however, it is the recommendation of the Committee that the next President again appoint a Bylaws Committee to work closely with the Ways and Means Committee in a further effort to arrive at an equitable solution to this problem.

Howard R. Greenfield
Gardner C. McFarland
Robert H. Peters
William L. Rusconi, Chairman

REPORT OF THE RESEARCH COMMITTEE

For members who have not followed closely the recommendations made by the Research Committees in recent years, these will be reviewed briefly so the recommendations of this year's Committee can be better understood.

In 1957 this Association unanimously supported the concept that the existing vector control research facilities of the State Department of Public Health should

be expanded and that adequate financial provisions should be made to support substantially improved facilities in the State Department of Public Health's research program.

In 1958 an ad hoc research committee under the chairmanship of W. Donald Murray recommended that "assured funds and adequate facilities to broaden existing programs" be secured. Legislative action was considered the best approach to the problem.

In 1959, under the chairmanship of C. Donald Grant, the Research Committee provided the Association with a feasible and procedural research proposal. This Committee also recommended that the Board of Directors place $500.00 in the 1960 budget for the development of a brochure which would be used in obtaining the endorsement of other agencies and individuals interested in the research proposal.

In 1960 the Research Committee, again under the able direction of C. Donald Grant, submitted a detailed, comprehensive report on the vector control and insecticide research needs of the Association. This report, coupled with the report submitted by Governor Brown's Special Committee on Public Policy Regarding Agricultural Chemicals, reaffirmed and amplified previous recommendations made regarding vector control research needs in California. Both of these committees recommended that an Ecological Research Center be established at the University of California under the direction of the State Department of Public Health. Based on the Research Committee report and the Governor's Special Committee Report, this Association by resolution again reaffirmed its support of a proposed Ecological Research Center.

The year 1961 might be characterized as the year of introspection. The University of California assembled a committee to examine whether or not the University was being fully responsive to the public's needs in vector control. The Bureau of Vector Control of the State Department of Public Hhealth reappraised its research programs, defining unmet needs in the light of the state's rapidly growing population and the problems inherent in such growth. The C.M.C.A. quietly but firmly continued to stress the need for a responsive agency to accept primary responsibility for the stimulation and coordination of research and development vitally needed by vector control agencies in California.

Your present Research Committee has carefully reviewed the recommendations of previous committees and past actions of the Association on the research question. It has also followed closely the recent joint deliberations of State Health Department and University of California officials. The Committee believes that although the proposed joint coordinated, cooperative research program (report appended) does not entirely fulfill the recommendations and resolutions submitted by this Association since 1957, it nevertheless is a positive step in that direction. The Committee therefore submits the following as recommendations:

(1) That arrangements be made to transfer subvention funds now allocated to surveillance to the continuing support budget of the State Department of Public Health for surveillance and related operational research purposes.

(2) That the Research Committee consider the feasibility of holding quarterly or semi-annual meetings with the State Department of Public Health Supervisor of Vector Research.

(3) That the Research Committee and the Entomology Committee develop lines of communication to facilitate a better understanding of the research needs expresed by Association members.

(4) That a study be made to ascertain priorities of specific research needs and to recommend projects that might be undertaken on the basis of these needs.

John H. Brawley
Sherburne F. Cook, Jr.
C. Donald Grant
Jack H. Kimball
Gordon F. Smith
Howard R. Greenfield, Chairman

Joint Report of the State Department of Public Health and the University of California on Mosquito Control Research

In response to the directive of the Senate Finance Committee relative to the feasibility of the University of California assuming the research responsibility for mosquito control, the respective roles and responsibilities in the areas of mosquito control research of the State Department of Public Health and of the University of California have been reviewed. In summary, the University of California has a broad interest and responsibility in the basic aspects of research on mosquitoes, but also follows through to the application of basic findings to practical problems and seeks direct answers to such problems. The regulatory, consultative, surveillance and control responsibilities of the State Department of Public Health require that it engage in mosquito control research where the present fund of knowledge is insufficient and other agencies are not pursuing the problems on an adequate time schedule. It is inevitable that the respective research roles of these two agencies contain some overlap of interests and responsibilities.

Expanded and intensified research is needed to fill many broad gaps in our knowledge of mosquitoes and their control. The combined resources for mosquito control research of the University of California and the Department of Public Health are much too small to deal adequately with these problems at the present time. Limitations of manpower, facilities and time have prevented both the University and the Department of Public Health from pursuing at appropriate levels the avenues of needed research. It is unrealistic and undesirable for either the University or the Department to assume sole responsibility for all research in this field; the solution of the many problems will require the support and collaboration of both agencies. It is agreed therefore that the best way of handling the overlapping interest and responsibility is a coordinated research effort by the University of California and the Department of Public Health. Adequate financial support will be needed to carry out fully the responsibilities of both the University of California and the Department of Public Health in this plan.

To facilitate such a program and to expand current collaborative efforts, the following plan has been effected:

(1) The University of California will continue to accept the major responsibility for basic research,

carrying its findings to the applied level wherever necessary.

(2) The State Department of Public Health will continue to conduct research necessary to carry out its regulatory, advisory, surveillance and control responsibilities when basic or applied research of other agencies is inadequate or will not meet critical time schedules.

(3) A joint committee of the University of California and State Department of Public Health has been established to coordinate their research efforts. This joint committee will develop collaborative projects where necessary, direct the attention of researchers and administrators to areas of research need or overlap, and in other ways coordinate and facilitate the research program. Therefore, the research programs of the two agencies will be independent, they will be closely integrated, and appropriate research will be conducted in a collaborative manner.

STATE DEPARTMENT OF PUBLIC HEALTH
Malcolm H. Merrill, M.D., Director

UNIVERSITY OF CALIFORNIA
Clark Kerr, President

(After a discussion of research needs the following resolution was adopted)

WHEREAS the Association recognizes the vital necessity of continued vector control research, and

WHEREAS the University of California and the State Department of Public Health are in agreement that increased research by both agencies is necessary, and

WHEREAS the Governor and the Legislature have been sympathetic to the needs of vector research in the past: Now therefore be it

RESOLVED, That the California Mosquito Control Association recommends to the Governor and the Legislature that adequate vector control research funds be provided to both the University of California and the Department of Public Health.

REPORT OF THE INSURANCE COMMITTEE

The Insurance Committee met twice during 1962. A questionnaire was sent to member agencies to accumulate information on the presence or absence of health insurance plans and to determine the desires of members relative to a state-wide group plan. The survey results have been tabulated and submitted for analysis to the agent handling San Joaquin County's health plan. The problems are numerous when statewide coverage is considered, and further work will be required by this Committee in 1963.

It is hoped that the newly appointed Insurance Committee can meet early in the year to consider this subject further, and determine the desired coverage before submitting its recommendations to the C.M.C.A. membership. At this time it appears doubtful that rates better than those now obtained by individual agencies with health insurance plans will be possible.

H. C. Pangburn
T. G. Raley
William L. Rusconi
Robert H. Peters, Chairman

REPORT OF THE AIRCRAFT COMMITTEE

This Committee held four meetings during the year. The first meeting was spent developing a questionnaire on the use of aircraft in mosquito control in California during the 1961 season. This questionnaire was subsequently sent to all mosquito abatement agencies in the state. The summary of information obtained was presented at the Fourth Annual Conference on the Use of Aircraft in Agriculture, Forestry, and Public Health held at Davis in July.

At the second meeting the initial questionnaire was revised and once again mailed to all agencies to obtain a report on their 1962 operations. A summary of this information will be included in the 1963 Year Book.

A special meeting of the Committee was called in December at the request of the Board of Directors to formulate specific recommendations on the proposed amendment to Section 55 of the Civil Air Regulations governing agricultural aircraft operations. Represented at this meeting, in addition to the Committee, were the C.M.C.A. Board of Directors, the State Department of Public Health, and the Federal Aviation Agency. The resulting comments pertaining to these Civil Air Regulations were sent to Washington, D.C. by the Board of Directors.

Our last meeting, held in December, was devoted to developing plans for the equipment show to be held in Salinas on April 5, 1963.

Recommended projects for the coming year include:

1. sponsorship of the equipment show;
2. publication of a handbook on standard methods of calibrating spray aircraft for use in mosquito control; and
3. preparation of annual summaries of aircraft use in California mosquito control.

Burton A. Fentem
Edward Lewis
Robert E. Porter
Dennis Ramke
Robert E. Turner, Chairman

REPORT OF THE ENTOMOLOGY COMMITTEE

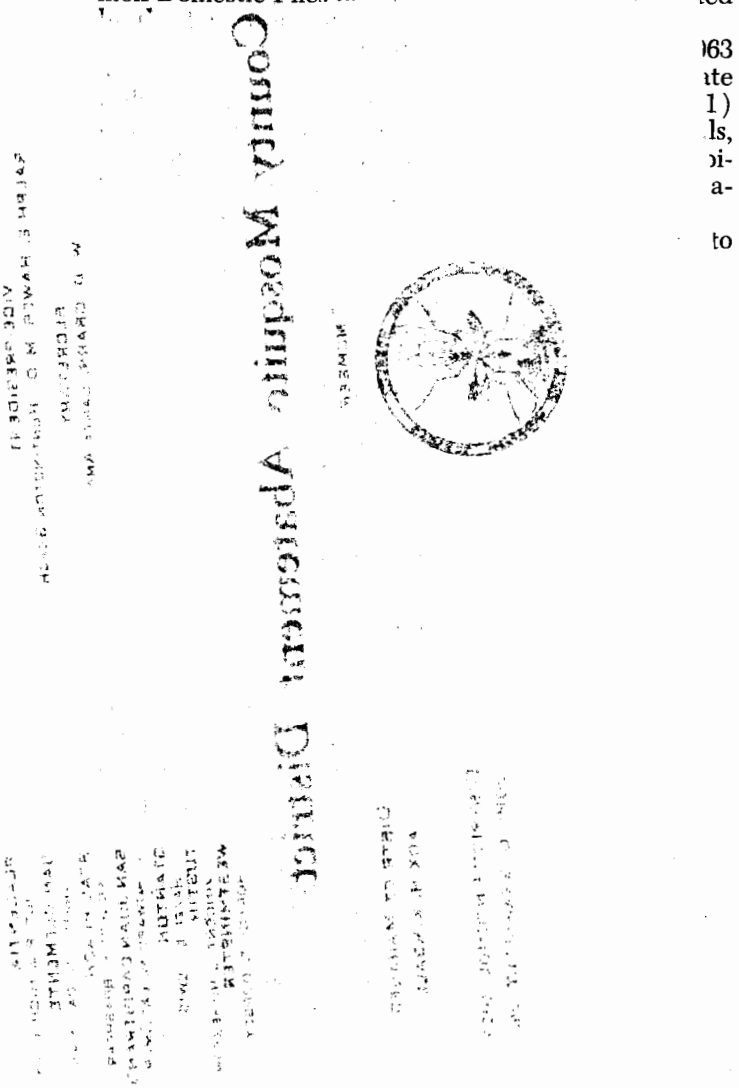
The Entomology Committee held four general meetings during the year. Nine meetings were held by various subcommittees during this same period to work on assigned projects.

The Sixth Annual Entomology Seminar, sponsored by this Committee was held on the Davis Campus of the University of California on March 23-24. Approximately 75 individuals participated in the discussions on (1) egg physiology of the mosquito, (2) egg ecology of the mosquito, (3) flight studies of *Culex tarsalis* in the Sacramento Valley, and (4) flight studies of *Culex tarsalis* in the San Joaquin Valley. Moderators of these subjects in the order listed were Drs. Charles L. Judson, of the Bureau of Vector Control, and Allan D. Telford, Stanley F. Bailey, and William C. Reeves, of the University of California. The banquet featured an illustrated talk by Dr. Edmond C. Loomis, of the Bureau of Vector Control, on the malaria eradication

program in Indonesia. An added feature of the Seminar was the presentation of the Entomology Committee's new publication, "A Field Guide to Common Mosquito-like Gnats of California".

The principal Committee activities in 1962 consisted of three projects. First, the Committee was notified by the C.M.C.A. Secretary that the supply of "A Field Guide to Common Mosquitoes of California" had become exhausted and that a second printing would be necessary. The revision of this publication, now nearing completion, includes a larval habitat chart covering all of the California species.

The second project consisted of the following: (1) development of functional, nontechnical adult and larval keys to 15 genera of the common domestic flies in California, (2) preparation of illustrations of one species representing each genera included, (3) preparation of a glossary of terms used in the keys and text, and (4) writing an ecological summary for each of the genera. Plans for publishing " A Field Guide to Common Domestic Flies of Californ[illegible] ted



...ssociation express its thanks to Agrinautics Sales (Pawnee and Hughes) for its sponsorship of the ladies' bus tour and luncheon.

5. That the Association express its appreciation to all exhibitors, sponsors, and sustaining members for their assistance in assuring the financial success of the conference, as well as for their part in presenting products of interest and value to the conference.
6. That the Association President send letters of appreciation to all speakers, sponsors, exhibitors, and sustaining members for their participation, which made the conference an outstanding success.
7. That the Association express specific thanks to Mr. Steen Weinold of the Miramar Hotel for his help in making conference arrangements.
8. That the Association express its appreciation to the Miramar Hotel for the excellent arrangements and facilities provided for the conference.
9. That the Association express its appreciation to the Convention Bureau of the Santa Barbara Chamber of Commerce, and to Miss Grace Dively, Secretary of the Convention Bureau for their great help and interest in making the conference a success.
10. That the Association express its appreciation to the local Arrangements Committee for its part in developing the conference.
11. That a letter of appreciation be sent to Dr. Malcolm H. Merrill, expressing appreciation for the participation of members of the State Department of Public Health in the Conference Program and for other help furnished.

Harold F. Gray
David E. Reed
Gardner C. McFarland, Chairman

REPORT OF THE NOMINATING COMMITTEE

Lester R. Brumbaugh, Chairman of the Nominating Committee, presented thet following slate of officers proposed by that Committee:

President	David E. Reed
President-Elect	J. D. Willis
Vice-President	William L. Rusconi
Past President	John H. Brawley
Secretary-Treasurer	W. Donald Murray
Trustee Member	Carl W. Muller

It was moved by Lester Brumbaugh, seconded by Ted Raley and unanimously carried that nominations be closed and that the secretary be instructed to cast a unanimous ballot for the officers recommended by the Nominating Committee.

Regional Representatives selected by their respective regions are:

Sacramento Valley	Kenneth G. Whitesell
Coastal	H. C. Pangburn
No. San Joaquin Valley	Gordon F. Smith
So. San Joaquin Valley	T. G. Raley
So. California	Torval M. Hansen

ALTERNATE SESSION

TUESDAY, JANUARY 29, 9:00 A.M.

SIGNIFICANT OPERATIONAL DEVELOPMENTS

EUGENE E. KAUFFMAN, *Presiding*

(Editor's note: In addition to the two submitted papers which follow, this session consisted of informal discussions on (1) techniques in locating mosquito sources; (2) precision in the application of insecticides; (3) essential safety measures in applying modern insecticides; (4) qualifications and responsibilities of an operator; and (5) the value of records.)

TECHNIQUES FOR LOCATING A MOSQUITO SOURCE

JAMES MALLARS
San Joaquin Mosquito Abatement District

Mosquito sources in many instances are well hidden, and often they are isolated or remote from the adult problem area. As a result, there are many factors to consider if one is to obtain the basic information necessary for successful control. The techniques which therefore must be used by the investigator in locating mosquito sources are many and varied.

For the sake of this discussion we might consider some of the techniques applicable to three distinct but typical problems:

(1) locating a source of *Culex pipiens quinquefasciatus;*
(2) locating a field source of *Aedes* mosquitoes;
(3) locating a field source of *Culex* mosquitoes.

Obviously a first action required is the collection and identification of mosquitoes creating the problem. An aspirator is generally used to collect the adults and a hand lens should be carried for on-the-spot identification. Numbers and proportions of males and females may provide clues to source, size, proximity, etc. Regardless of the species associated with the complaint, a few key questions asked of the property owner and neighbors may shed light on the problem at the outset.

Culex pipiens quinquefasciatus.—When the source of this species is being sought, a thorough evaluation of the area is a basic prerequisite. Consideration should be given to the common types of sources in the particular locality as well as the less obvious possibilities. Some of the less apparent sources include abandoned sewer lines, public utility vaults, inoperative water coolers, residual water inside industrial buildings, dwellings constructed directly over cesspools, water on flat top roofs, compartments or depressions beneath barn floors, vaults in Imhoff tanks, small springs hidden in ravines, etc.

If the source has not been located after a reasonable period of initial investigation, thought should be given to topography and other factors. Mosquitoes may move a considerable distance across dry fields or vacant lots interspersed among houses. Movement may also occur up and down ravines and hillsides.

Occasionally septic tanks may appear to be well sealed but conceal improper vent lines or piping systems allowing entrance and exit of mosquitoes. Inspection of vent pipes is then necessary to isolate the active source. Pinhole openings in septic tanks are also overlooked at times and require careful inspection if one is to locate the mosquito source. When mosquitoes emanate from sources with very small openings, they may disperse in small numbers, are difficult to capture, and generally offer little in the way of clues as to their point of origin.

Light traps are sometimes helpful in taking adults for purposes of evaluation. Mapping or otherwise evaluating service requests often leads to the discovery of a source which may be allowing mosquitoes to filter into a primary problem area. In addition, if the agency maintains a filing system which includes a record of sources this can be checked and thereby often save the inspector considerable time.

Team inspection by a pair of experienced personnel is often the most effective procedure for locating sources since exchanging ideas and information on the history of an area tends to establish the pattern of circumstances bearing on a given problem. If the mosquito control agency employs premises survey personnel, they may be moved into the problem area to assist in locating the source.

After the suspected source has been found and corrected, post-treatment inspections are quite often important. If more than one source is contributing to the problem, this should be determined quickly and appropriate action taken.

Field Aedes Mosquitoes.—When one is confronted with locating *Aedes* sources in the field, a review of the farming practices of the locality provides many clues. Such considerations as frequency of irrigation, superimposed irrigation cycles, irrigation methods, nature of crops, previous history of the area, and soil characteristics may influence the investigator's inspection procedure. Adult densities and pattern of dispersal are helpful in pinpointing sources. Any residual irrigation water or wet soil with evidence of pupae or pupal cases provide significant clues to what may have happened. Follow-up of suspected sources during the critical period of the next irrigation cycle may be necessary to confirm one's findings.

Seasonal practices, especially where irrigation cycles or cultivation practices are changed to meet crop requirements, often have a pronounced influence on *Aedes* production. Soils in orchards or alfalfa fields, for example, may become saturated; this may result in larger volumes of water remaining for longer periods, causing new or increased *Aedes* development. The continuous seeding of eggs in obscure small pockets hidden in unsuspected fields may eventually lead to high larval densities and greater dispersal with increased irrigation.

Field Culex Mosquitoes.—Locating sources involving species such as *Culex tarsalis* or *Culex peus* is often time consuming and sometimes presents a real challenge. In addition to many of the techniques already described, one should consider old, inactive sources which may have been reactivated, as well as changing agricultural practices or the more obvious features of urban development which might be responsible for new sources. Consulting other staff within your organization may provide additional clues to the problem. In any search for obscure mosquito sources the zone operator's schedule of inspection and larviciding should be considered carefully. An operator or an inspector previously assigned to the area can sometimes offer information that could only be gained by long and intimate familiarity with the area. The residents of the area may also be able to give helpful clues since they often possess an accurate knowledge of the history and physical features of the locality.

Where a large area is under consideration, dividing the work geographically among available personnel will reduce the time required to locate troublesome sources during critical periods of operation. Aerial photographs, if available, may provide an over-all view of potential sources, including drainage networks and other possible sites that might be overlooked during a field survey.

In addition to standard survey equipment such as light traps and artificial resting stations, the recently developed age determination techniques may sometimes be used advantageously.

Keeping abreast of current literature on new techniques and equipment, new information on mosquito behavior, flight patterns, etc. will make the job of mosquito source detection easier, as well as more fascinating, and will result in a higher degree of success.

THE VALUE OF PREMISES SURVEYS IN A MOSQUITO ABATEMENT PROGRAM

JAMES MALLARS
San Joaquin Mosquito Abatement District

A well organized mosquito control program includes intensive inspection, larviciding, and reduction or elimination of major as well as minor mosquito sources. This is accomplished by thorough training of personnel, careful division of labor through zoning, and precision planning of field operations. Work loads must be geared to weather as well as to cycles of mosquito development, so that coverage of all primary sources will be assured.

Many miscellaneous small sources also exist, requiring additional coverage in urban and certain rural areas if one is to realize anything approaching complete freedom from mosquito annoyance. This task is accomplished in the San Joaquin Mosquito Abatement District by college students or high school teachers who are employed expressly for premises survey work during the summer; permanent employees are also called upon to do certain kinds of premises work in the winter.

Both permanent and temporary personnel are given intensive training on mosquito biology, larviciding methods, potential field hazards, as well as personal conduct and public relations, including certain psychological techniques which are useful in establishing good rapport with the homeowner. Motion pictures and particularly colored slides which show the various types of sources are utilized in training. Through the use of these kinds of training aids the difficult and less obvious sources such as septic tanks and plumbing systems, as well as other backyard sources, along with the procedures followed in their correction, are more easily clarified.

Premises inspectors normally work in pairs, operating on opposite sides of a street. They work under the direction of a supervisor who provides further training in field techniques on the job.

Based on the experience of our District, many urban backyard sources which might otherwise go undetected are found and corrected. This reduces the number of service requests, improves public relations, and provides more time for key personnel to attend to major field operations. In certain rural communities many sources are detected which the permanent inspector-operator cannot locate because of his heavy work load on major sources. At times the experienced premises personnel may be utilized for certain larviciding or weed control tasks.

During the 1962 season the San Joaquin Mosquito Abatement District's premises survey workers completed 34,396 house-to-house inspections and recorded 4,807 potential backyard sources which amounted to 10% of the total. Of the total figure, 1,566 inspection reports were issued and 2,779 minor corrections were made, such as emptying artificial containers, screening certain sources, etc. In addition, there were many opportunities to instruct householders on preventive techniques. A total of 1,219 septic tanks and drains were also corrected during this period. Analyzing the results of this work in retrospect, considerable mosquito production could result from these sources if not corrected.

In addition to considering the problems of mosquito control, residents have an opportunity to inquire about other insects or related problems. The premises workers usually refer such inquiries to qualified personnel who provide the desired information directly or refer it to an appropriate agency. This affords the District a basis for closer inter-agency liaison, and the end result is higher public esteem of service organizations.

FOURTH SESSION

TUESDAY, JANUARY 29, 1:30 P.M.

TRUSTEE PROGRAM

MARION C. BEW, *Presiding*

Mr. Bew: I have been asked to announce that the Board of Directors met this noon and decided that next year's annual conference will be held in Sacramento during the latter part of January.

As you know, and as indicated on the program, this afternoon's session will focus on information and problems of special concern to mosquito abatement district trustees. We have a full schedule so I shall get right on with the program by introducing the first speaker, who is William F. Norman, a trustee for the Merced County Mosquito Abatement District and Director of Sanitation for the Merced County Health Department. Mr. Norman—

THE VALUE OF WRITTEN, COMPREHENSIVE ADMINISTRATIVE POLICIES TO TRUSTEES AND MANAGEMENT OF A MOSQUITO ABATEMENT DISTRICT

WILLIAM F. NORMAN
Trustee, Merced County Mosquito Abatement District

My comments relative to written comprehensive policies will be rather brief as the necessity and the benefits of this administrative tool are well known to all of you. However, I may be able to stimulate some interest in the possible need for bringing written policies up to date and to make them a matter of official record. It has been evidenced here at this meeting that mosquito control is more complex today than ever before. The concern of the Fish and Wildlife Service and other agencies relative to our application of insecticides and possible residuals on food products, and the concern of the public in their ever awareness of tax dollar expenditures, behoove us to provide our managers with sound administrative guides.

Written comprehensive policies provide a permanent record of a board's past performance, and indicate to a considerable degree the path which the board will take in the future. Written policies eliminate dissension among board members and the necessity for personal interpretation regarding various situations that continually arise. They provide for decisiveness of action and constitute an impartial guide where decisions regarding unforeseen situations arise. Such established policies provide for continuity of district action from year to year. This gives stability to the board, resulting in improved public confidence in the board's actions and recommendations. They are a great help to new board members who in most cases have little or no knowledge of mosquito district operations. Written policies make for a more business-like operation, especially at board meetings held before public audiences, newspaper reporters, or at hearings concerning district operations. Written policies help to guard against domination by one or two aggressive members and reduce the possibility of a board being persuaded or pressured into making decisions based on personal interests.

Written policies can be formulated after deliberate discussion, thus eliminating the necessity or possibility of hasty decisions which may prove unsatisfactory in the long run. The policies should be as comprehensive as possible and include guiding principles covering foreseeable basic situations. Policies should never be final; additions or changes may be required in order to adjust to changing conditions. In like manner, certain policies may of necessity be eliminated when they become obsolete or otherwise prove undesirable.

Administrative policies are particularly valuable to the management of a district since they are available at all times for ready reference when problems arise. This frequently eliminates the necessity of making time-consuming and sometimes costly phone calls or calling special meetings of the board. The written comprehensive policy should be well organized for ready reference, and defined as completely as possible in clear, concise language, eliminating the possibilities of any misunderstandings.

The policy manual should include an administrative chart showing distinct lines of authority and responsibility. It should include general staffing requirements, minimum qualifications for administrative staff, job specifications for all classes, duty statements, probation policy, and other related matters. It should cover the rules of order for the board, the meeting time and meeting date, policies governing travel of district personnel and board members, policies regarding accounting, source reduction, responsibilities of land owners, and the use of district equipment. It should cover such personnel matters as salaries and wages, vacations, fringe benefits, sick leave, compensating time off for extra work, special leaves, timekeeping and termination of employment.

This administrative tool is the foundation from which your manager works. Without it I don't see how a district can operate. I have made a partial survey of district operations and find that many districts do not have such a manual. Some districts have a manual that is in the archives of the library and not used. Our policy manual is on the table at every meting, is continually referred to, and is continually adjusted to changing conditions. I would urge all boards of trustees to review their policy manuals, bring them up to date, and use them.

RESPONSIBILITIES OF MOSQUITO ABATEMENT DISTRICT TRUSTEES

O. R. STRONG
Trustee, San Joaquin Mosquito Abatement District

As you know, the conference theme is on communication and, of course, there are many ways in which we can communicate. We heard some very interesting talks on this yesterday. When I heard these talks on communication, I was reminded of the time just a while back when I attended the 50th wedding anniversary of John and Martha Winters, and everyone in our area knew the type of man John was, a hard man to get along with. So at the reception I asked Martha how she had gotten along with John all these years. She said, "Well, I just learned early to keep my mouth shut and not to talk back. I learned this lesson on our wedding day, but let me tell you about it." So she began. It seems that as they left the church they got in the buggy and started out on their honeymoon to Niagara Falls. On the way one of the new-fangled cars came across the road and the horse reared up and balked. John didn't say a word to her, he just got out and looked the horse in the eye and said, "That's one!" So they went on towards Niagara Falls, and after a while a train came by and blew its whistle. Again the horse reared up and John just said, "That's two!" Later on as they got within a short distance of the falls, lightning struck and with the big noise of thunder the horse reared up again. John got out of the buggy, walked around in front, pulled out his gun and shot the horse dead. Martha said, "I was so stunned I just couldn't say a word. John picked up our luggage and went on up to the hotel and when we got in the room I started to talk. I said, 'Now, John, that was an awful thing to do to that poor horse. Aren't you ashamed of yourself? What have you got to say for that?' " Whereupon, she said, "He looked me square in the eye and answered, 'Martha, that's one!' " From that point on they had a happy married life.

I wish to take this opportunity to thank the California Mosquito Control Association for arranging the program to include sessions in which trustees can participate, where we can exchange ideas and new information which will be helpful in the conduct of our work.

Everyone likes to be associated with success, and one of the main prerequisites of success is the assumption of responsibility. In every business the board of directors or trustees, the president, manager, and employees must assume certain amounts of responsibilities in order to achieve their goals. What are these responsibilities? For those of us in mosquito abatement work in California, the Health and Safety Code spells out the responsibilities of boards of trustees of mosquito abatement agencies. These laws are published and available to all and I am not going to take the time to review them today. I thought I would talk to you more or less on an informal basis, discussing with you some of the unwritten responsibilities. I have listed four which I believe all trustees should recognize if we are to reach our goal.

First, we must develop and maintain a cordial working relationship with our fellow board members. Perhaps this can best be done by creating an atmosphere at board meetings which is business-like and at the same time informal. Whenever possible a trustee should attend district social functions, such as picnics, barbecues and other outings, to become better acquainted with his fellow board members in a different atmosphere. In our district we have at least two such outings each year. Incidentally, we pay our own way. As a result of these informal gatherings we get along wonderfully with each other.

The second responsibility is that of keeping well informed. I have in mind here the reading of district activity reports and memoranda and, of course, the A.M.C.A. *Mosquito News* and various other mosquito publications that can help us do a better job.

Third, assist new board members. Each board member should help a new member in understanding his duties and responsibilities, and board policies. A good time for this is during coffee sessions prior to the board meetings. We have this arrangement and I hope the rest of you do. It is a real good get-acquainted session. Another way of orienting a new member is through our field trips where we visit major mosquito sources and have general discussions about them. The new member can gain a lot here.

Fourth, observe the proper division of responsibilities between the board and management. When individual board members try to assume responsibility for hiring and firing and directing purchase of supplies, minor chaos can develop. The manager not only loses face with his empleyees, but he loses authority and unison with this board.

It is my belief that these unwritten responsibilities are just as important to the effective operation of a mosquito abatement district program as are the legal provisions under which we operate.

RELATION OF SPECIAL DISTRICTS TO CITIES

HOLLIS M. PEAVEY
President, Board of Trustees
Southeast Mosquito Abatement District

In speaking on the subject given to me, I must wear two hats. Along with being president of the board of the Southeast Mosquito Abatement District, I am also Vice-Mayor of the City of Downey.

As for the relationship between mosquito abatement districts and cities, and how we can cooperate—I don't think that has been adequately explored. I am going to use my district as an example because every district is somewhat different and I can speak better of that with which I am familiar. When our district was first organized it was actually an operation of city councilmen. It was set up for the simple reason to curb mosquitoes and it has worked out very well. As time goes on we keep adding more cities and other portions of the county. This is what is being referred to now by some misinformed individuals as an "overlapping dis-

trict." These are the people who are continually talking about metropolitan government, and how they could save the taxpayers' money by doing away with overlapping districts. When we set up our districts we set them up to take care of mosquito problems. The mosquito doesn't care where a district starts or where it stops. If one city were to try to control its own mosquitoes and an adjacent city didn't, you know what the result would be. So our districts are usually set up to cover several cities or perhaps several different governmental jurisdictions. Recently we heard of various attacks on the overlapping districts. About two years ago the Governor set up a committee to study metropolitan government. A bill was submitted to the Legislature which was intended to lead up eventually to metropolitan government. Under this propostion if two cities decided they wanted to set up a district for one thing or another, say for a fire department, they could include a third city and the two cities could well have enough power to take in this other city that might not want to come in. That would be going into metropolitan government via the back door. The League of California Cities at first thought it would go along with this and it reached a point where we had to call up the Board of Directors and get them to hold a state meeting, attended by 376 mayors throughout the State of California. They voted it down unanimously.

The reason I am mentioning this, gentlemen, is that our mosquito abatement districts are involved in this, too. Now, first of all, I assure you these big over-all governments are not economical; they are expensive. If you will check the tax rate of our larger cities in California you will find that they are much higher than those cities of 100,000 or under. It has become a well-known fact with municipal people down through the years that when a city reaches 100,000 it becomes unwieldy and can't take care of its public services properly.

Now it is my belief, gentlemen, that we are all in the same boat. If they wipe out the cities, if they wipe out home rule, they wipe out or destroy the mosquito districts in some metropolitan areas. There is one thing that we should bear in mind—with the long, practical, down-to-earth experience that our people have had in mosquito abatement, it would take a long time for a new type of agency to reach the point of doing an equivalent job.

I can only say this in closing. Thus far in the present legislative session we haven't found any bills being proposed that would affect the districts in this respect. If the cities are affected, the districts are going to be affected because the cities help organize and are a part of these many districts. Our district, and I know this is true of many others, is what they are calling an overlapping district. Therefore, we should all be alert and, if it becomes necessary, be prepared to call on our assemblymen and at least give them an informed opinion. Last year, through the League of California Cities, we were able to slow this down and stop it, we hope, but the issue is apt to come alive again. So all I can do here is to alert you as to what has been going on, in case you are not aware of these recent developments, and to urge you to watch for possible future activity on this issue. Thank you very much.

SHOULD A MOSQUITO ABATEMENT DISTRICT BE INVOLVED IN INSECT CONTROL OTHER THAN MOSQUITOES?

EDWARD E. ENOS
Trustee, Alameda County Mosquito Abatement District

Since receiving an invitation to appear on this program I have been anticipating the occasion with a great deal of interest. Primarily, I have been looking forward to a discussion with those of you to whom the call has gone out in many areas to take over control of insects other than mosquitoes. Secondarily, I wanted to discuss with you some of the practical aspects of fly control.

I have divided my talk into about five considerations. The first is that of district powers. It might be well at the outset to quote the section of the California Health and Safety Code which gives the district board of trustees the power to ". . . take all necessary or proper steps for extermination of mosquitoes, flies, or other insects, either in the district or in the territory not in the district but so situated with respect to the district that mosquitoes, flies or other insects from such territory migrate into the district."

The second consideration is that of service. We should bear in mind that mosquito abatement districts are public service agencies. In view of this if the people demand a specific service which we are authorized to provide, then we should give them that service. Several districts have already undertaken gnat control or fly control.

The results of investigations indicate that there are several main sources of domestic flies, including household garbage and other back yard sources such as layn clippings, industrial wastes, and livestock and poultry manure. According to the most recent California surveys, these are the primary or major sources of domestic flies.

To combat this problem—a man-made problem, incidentally—several avenues of approach have been suggested: (1) education of the public as to the proper disposal of garbage—illustrated so well yesterday afternoon in that excellent talk by Mr. St. Germaine from Santa Clara County; (2) an extensive campaign to improve refuse management through use of proper containers; (3) twice-a-week pick up of garbage; and (4) improved farm management and sanitation programs.

Scientists have shown that in some areas the average garbage can may produce as many as 1200 flies per week. However, in such a situation, with two garbage collections per week, the figure dropped to an average of 120 flies per can per week. In other words, 10% of the flies developed in the first four days and 90% developed in the next three days. Now, the house fly cycle during the warm weather is approximately this: (1) egg to larva, ½ day or longer; (2) larva to pupa, 3½ days

or longer; (3) pupa to adult, 1½ days or longer. So you see that the period from egg to pupa may be as short as 4 days. Thus, you can really get into trouble after the 4th day.

The third consideration is that of financing. Financing a project or a new program is a matter of great importance. At present a district may levy up to 15 cents per $100 assessed valuation. If we go over the 15 cents we must petition the board of supervisors, and with their consent we can levy up to 40 cents. The question arises as to whether or not a comprehensive fly control project would be economically sound. Highly trained employees would have to be hired. The cost to the district could be as much as three times the present cost of operation. In my particular district, which has about 300,000 housing units, the garbage in some areas should be collected twice weekly, at least during the warm season, thus imposing a heavy cost upon the patrons. However, this is the largest source of flies in many urban areas and, therefore, one which we must confront. The people provide the breeding sources for flies; therefore, it is just as possible for them to prevent the breeding of flies.

The fourth consideration is enforcement. A question may well arise in the area of enforcement, as well as in terms of service, which I might call, for lack of a better term, the tolerance level, or the threshold of annoyance. In other words, when shall a district representative respond to a home call? Shall it be 2 flies? Shall 3 flies be the deciding point? One mosquito is sometimes enough to result in a call. Will the same be true of house flies?

The fifth consideration is that of control. Several sources of technical information are available for the control of flies: the University of California, the State Bureau of Vector Control, the State Department of Agriculture, and others.

It takes moist organic material to produce flies; dry material will not produce flies. Flies can be prevented in waste material by (1) spreading it thinly to dry; (2) cultivating it into the soil, (3) storing it in a fly-tight bin, (4) covering it with a tarp, (5) gathering droppings daily and burying under 6 inches of compacted soil.

I hope that in this discussion I have kindled a spark of interest in each of you so you will go home and study this problem further. You may some day be called upon by the board of supervisors or by a citizens' committee to provide this kind of extended service. In Contra Costa County a citizens' committee was actually formed and they appeared before the board of supervisors, as I understand it, and said, "We want fly control now." As a result, the Contra Costa County Mosquito Abatement District is in the fly control business. You may have that occur in your area, just as we are having to give it serious consideration in Alameda County at the present time. This will require careful thought, but I am confident that it is a problem that can be solved.

REQUIREMENTS FOR ANNEXATION TO MOSQUITO ABATEMENT DISTRICTS BY NEW SUBDIVISIONS

ALFRED J. ENGLE
Director of Sanitation
Santa Barbara County Health Department

After having encountered considerable resistance to expansion of the existing abatement districts or to the formation of additional abatement districts here in Santa Barbara County, we have resorted to a procedure which, to the best of our knowledge, is unique. We have had tremendous subdivision growth here in the last few years. Basically, there are two procedures which we are using for the expansion of mosquito control in Santa Barbara County as this service relates to the growth of subdivisions. Both procedures involve the following county agencies: Planning Department Subdivision Committee, Health Department, Special Districts Coordinator (a new office we have had here for less than a year), office of the County Council and, of course, the Board of Supervisors. In addition to the aforementioned governmental agencies, the existing mosquito abatement district in the vicinity of the proposed annexation is of course involved.

The first procedure we will consider involves the annexation of noncontiguous subdivisions to a mosquito abatement district.

The second procedure which I want to talk about, and this is still in somewhat of an experimental stage, involves the formation of a mosquito abatement district as a condition of final approval of a subdivision wherever mosquito control is needed and where no district exists within a reasonable operational distance.

Returning to the first procedure, the annexation of noncontiguous proposed subdivisions, I am sure you are all familiar with the sections of the Health and Safety Code, Article VI, Sections 23-30, which read as follows: "Any territory lying contiguous to a mosquito abatement district may be annexed to the distric; noncontiguous territory may be annexed by the district if the board of supervisors of each county in which a portion of the territory proposed to be annexed determines by resolution that such portion of the territory is within a reasonable operational distance of the district." The action starts when the subdivider presents his preliminary map to the Planning Department for consideration. The preliminary map is then presented, usually by the subdivider's engineer, to the County Subdivision Committee, which is composed of department heads of Planning, Roads, Public Works, Health, Fire, Flood and the County Special Districts Coordinator. Prior to presentation of the preliminary map to the Subdivision Committee, the Planning Department has determined that the proposed subdivision is located, we shall say, in the Goleta Valley but is not within the boundaries of the Goleta Valley Mosquito Abatement District, nor is it adjacent to the district. As the preliminary map is considered by the Subdivision Committee, jointly with the subdivider, the matter of annexation of the proposed subdivision to the various districts of the Goleta Valley is brought to the attention of the subdivider, including annexa-

tion to the Mosquito Abatement District. There are sanitary districts, lighting districts, and various other districts, and we always include the mosquito abatement district when we meet with the subdivider. Following the Subdivision Committee meeting, the Subdivision Committee submits a generalized report on the preliminary map to the subdivider, which includes the matter of annexation. The Subdivision Committee, at a later date, reviews the tentative map of the proposed subdivision and submits a report to the subdivider, giving tentative approval of the subdivision which contains, for example, the following condition (this is a condition of approval): ". . . subdivider shall petition the Board of Supervisors for annexation to the Goleta Valley Mosquito Abatement District." The tentative map is later approved, including the aforementioned condition and, of course, other conditions by the Planning Commission and the Board of Supervisors.

It is at this point that a tentative map of the proposed subdivision is made available to the Mosquito Abatement District by the Health Department. The final annexation of the subdivision to the Mosquito Abatement District is usually approved by the Board of Supervisors at about the same time as the final map of the subdivision is approved. At a recent meeting of the Board of Trustees of the Goleta Valley Mosquito Abatement District two problems with this procedure were brought to our attention. First, the district may not wish to accept certain subdivisions due to location with respect to existing boundaries and the necessity of treating large surrounding areas which are not in the district. This, however, has not become a major concern as yet. Second, an immediate problem concerns the cost of publishing required legal notices in the newspaper. The most recent publishing costs of legal notices for a subdivision annexation were between $90 and $100. The district felt that they could not absorb this cost and therefore they are exploring the possibility of charging an annexation fee to the subdivider which will cover this cost. Also, the district would like to be able to publish a legal notice in the newspaper which would include several subdivisions or units of a subdivision at the same time rather than piecemeal. By doing this, publication costs would be somewhat lower. I understand they are having some success along this line.

Most of our recent subdivision activity has been in the Goleta Valley area. During the past year there have been 13 subdivisions, ranging from 10 to 65 acres, that either have been annexed or are in the process of being annexed to the Goleta Valley Mosquito Abatement District. We have had trouble over the years expanding mosquito control in this area and we feel that with this approach eventually we may be more successful than trying to go all out on a big program, although we still are working on that, too. There are nearly 500 acres in these 13 subdivisions that are in the process of annexation.

The second procedure, which is even more so in an experimental stage, involves the formation of an abatement district as a condition of approval of the subdivision in areas where mosquito control is needed and where there is no existing district within a reasonable operational distance. We have one such area 75 miles from here, which is not within an existing district, where we do have a periodic mosquito problem. We cooperate with the residents and provide the best program we can. We have tried, unsuccessfully thus far, to get them to form a district. This second procedure was instigated by a proposal of a large subdivision, which included several lakes and a golf course. Residents in the general area of the proposed development refused to form their own abatement district; however, some of them have indicated their willingness to annex to the new district if one is established by the subdividers of the proposed development.

Conditions to the subdivider on the preliminary subdivision map approved for the proposed subdivision in this case are given in a letter that was sent by the Subdivision Committee to the subdivider: "Upon reviewing the preliminary map we find several lakes are to be created as part of the golf course development. Inasmuch as the area is already considered a critical area for the breeding of mosquitoes, we recommend that you take the necessary steps, requesting the Board of Supervisors to form a mosquito abatement district, thus establishing an adequate control program to include the entire proposed development. Our department, the office of the County Council, and the State Bureau of Vector Control will be pleased to assist you in the necessary procedures for the formation of a mosquito abatement district."

This matter is still under study at the County Council's office, and just before I came down here I called him and asked him how it was progressing. The subdivision has not become completely inactive, but it has slowed down. He says that from what research he has done he sees no reason why they can't require this subdivider to approve starting a mosquito abatement district in the area. There have been no objections to this condition from the subdivider; however, he has not yet requested tentative approval of his proposed development. Similar conditions have been imposed by the Subdivision Committee on more recently-proposed subdivisions in areas adjacent to the proposed golf course subdivision development. These subdivisions have generally indicated their willingness to participate in the formation of a mosquito abatement district, sharing the cost with the original subdivider of the area. I believe that is about all that can be said at this time of our progress on the application of these new procedures of annexation.

WORKING CONDITIONS AND SALARY SCHEDULES FOR MOSQUITO CONTROL AGENCIES

RALPH PIEPGRASS
President, Board of Trustees
Delta Mosquito Abatement District

First, I should like to touch upon the subject of working conditions. Some thirty years ago when I first came to Visalia I was talking to a man, who incidentally is still alive, and he was telling me about threshing. He said, "I used to work for the best threshing

outfit in the district. I had the best boss and if I wasn't the best man on the crew, I was trying to be the best man on the crew." I couldn't help thinking of that conversation when I started to reflect on the subject of "working conditions." If every organization was like that, what ideal working conditions we would have. If the boss thinks he has the best crew and the crew thinks they have the best boss and the best equipment, that is an unbeatable combination. Certainly this ideal situation is something to aim for in a mosquito abatement district, or in any agency of government. If the leaders and the staff of an organization have this basic philosophy there could be little doubt as to the quality of public service they would be prepared to offer.

The board of trustees of your mosquito abatement district provides the liaison between the electorate, or the taxpayers, and your manager and his working personnel. To attain the ideal set of circumstances I have described, certain conditions have to prevail. I have listed some of these conditions in the order of importance as they occurred to me.

Your manager should have a program. He should convince his board that it is a sound program that will bring the desired results. He should convince the men working under him that this is the program they should carry out to get those desired results. He must have confidence in this program to sell it to his board and to his staff. Then the manager must have the confidence of his board of trustees; they must believe the manager they have selected is capable of carrying out this program so they will be prepared to give him full support. Then if the working staff have instilled in them this esprit de corps and professional pride, knowing they have a job to do, that they have a leader to show the way, and that they are going to get the job done with precision and dispatch—that makes an unbeatable organization. If you have this, you can be assured of the most important thing—the complete confidence of the people in your district.

How many of you as trustees have had someone come to you with a complimentary remark about a man on your staff, an operation of the district, or something pertaining to the district program that is commendable? More to the point, have taken the trouble of notifying your manager of this fact? They will appreciate hearing that others believe they are doing a good job. You don't need to worry about the complaints; they will hear about them. But just a little word of praise once in a while will let them know that they are appreciated and that they are doing a good job.

In our district we have gone just recently to providing caps and shirts with the agency's name on them. The men take pride in wearing this uniform. If the men have pride in their organization they are going to do a better job.

Another important thing is to have adequate, good equipment. You can't expect a man to do a top job with inferior equipment. If all these things are taken into proper consideration it is possible to build up an organization that has the respect of the public, and you will have a satisfied staff that will accomplish the job as you would like to see it done.

We should perhaps now get on to the subject of salary schedules. First of all, I am not going to pretend to be an authority on this subject, nor am I even going to suggest that you should have a salary schedule in your organization. I would, however, like to present a few general thoughts I have concerning salary schedules.

Each district must establish its own criteria for determining what it is going to pay its manager, entomologist, foremen, source reduction man, engineer, pilots, operators, secretary, and any other special classes. What are these criteria? These may take into consideration such things as budget, and perhaps the special programs of the district. Some districts set salary schedules on a basis of what the county pays for other jobs requiring similar educational background and experience. Some set their schedules on the basis of what is paid in other mosquito abatement districts.

I think all of you receive the annual summary of the CMCA on "Mosquito Control Agencies Salaries and Working Conditions." Out of approximately 52 districts in the state, 44 sent in reports last year. Our board studies these documents carefully as we consider salaries from year to year; however, these do not constitute our main criteria.

It is quite interesting to check through this document each year. Of the 44 districts that reported last year, 25 had annual budgets of over $100,000. In one district the manager's salary amounted to 30% of the total budget. In another district the manager's salary was 3% of the total budget. So, undoubtedly, setting up a salary schedule on the basis of budget has its limitations. In one of the districts the pilot, working under the supervision of the manager, receives more pay in a 12-month period than the manager. Is he actually worth more to the district than the manager?

Should we as trustees of districts some way get together and try to determine how we arrive at some of these figures, and make an effort to develop more uniform salary plans? I don't know. I do know that we are all limited to the amount of money that we can raise for salaries, equipment, equipment maintenance, insecticides, insurance and so forth, and it has to go around. I hope that some of you will tell us how you determine salary schedules so we can take this information home and report it to the members of our boards who are not here.

Mr. Bew: Thank you very much, Ralph. Does anyone have the answer?

Mr. Peavey: I would just like to make a suggestion here. Our council during the past few years has had to wrestle, as every agency does, with pay and the matter of removing the council and its administrator away from the responsibility of setting pay scales. It is easy to bring about enmity within an organization where employees may feel that personal considerations bear too much influence. Perhaps some of you do not know it, but it is possible to hire experts from the State Personnel Board on contract for a very modest fee, and these men will come into your city or into your district and survey this problem in a detached objective manner and give you a scale based upon all of the appropriate considerations. We have done this twice and it is very effective.

FUNCTIONS AND PROCEDURES OF A MOSQUITO ABATEMENT DISTRICT BOARD OF TRUSTEES

A. SANDY STEINER
Trustee, Orange County Mosquito Abatement District

First I should like to say how happy I am to be here again at the annual conference of the California Mosquito Control Association. I represent a board, as you have heard, with 25 members. We have 4 charter members who have been on the board 15 years, one man has been on 12 years, and I am next with 10 years. In 1960 we had 3 new trustees appointed, 4 in 1961, and 6 in 1962. Every time we incorporate a new city we have a new member.

The functions and procedures of the board of trustees have been reviewed quite completely by Mr. Strong and the other speakers ahead of me, so I would just like to comment on some of these points and tell you how they apply in our district. It is the only one I really know—I have never visited another district's board meeting I'm sorry to say. I gain great satisfaction from these annual meetings, and the information I gather from discussions with other trustees and the professional mosquito control people is invaluable. Perhaps one of the more important functions, or responsibilities of a trustee is to accumulate as much knowledge and technical background as possible in order to serve the people he represents in the most intelligent manner possible.

I am very happy to report that we have very smooth, orderly, interesting meetings. When it comes to serious issues we take them up in a very business-like manner; the president conducts the meeting according to *Robert's Rules of Order*, we take action on all our discussions and matters of difference are settled in an orderly manner. Our manager must be given credit for our meetings running so smoothly. His detailed agenda and reports are largely responsible for this.

As for our procedures, we meet at 3:30 on the third Friday of every month, in a nice room where everything necessary is set up for us. We have coffee, soft drinks, and cookies available, for which we each contribute a quarter. We start the meeting on time with a roll call, and get to the business at hand. We usually adjourn not later than 5 o'clock. We have a large district and a great many things to accomplish; however, according to the procedure we follow, the preliminary work is already done for us. One week prior to the meeting an announcement is mailed to each of us. An agenda of the meeting is attached, along with the minutes of the previous meeting. This gives us everything we need. We have a week to study this material so when we come to the meeting we are prepared.

I have never been in the field to look at mosquito problems except in the area where I live. Yet I feel that I am familiar with every mosquito problem, every major nuisance, because at each meeting we are shown color slides giving this information in detail—such as problems created by dairies, by excavations, or by duck clubs. These pictures show the situation so clearly that we couldn't get a better understanding of the situation even if we got in a jeep, put on hip bots, and went out to the site.

As a board we are always prepared to give our manager complete support when he needs it. We know the powers we have according to the law and we try to exercise these powers in the most judicious manner possible. If a landholder is uncooperative we don't threaten or abuse him. The manager contacts him, or the entomologist may talk to him. If that doesn't suffice, he is sent a letter and informed of his responsibility under the law. If that doesn't work, we ask him to appear before the board. If necessary he is told to abate the nuisance or the district will take the necessary steps according to law.

The first year I was in the district I learned that the largest landowner in our county was leasing property to duck clubs and to a sugar factory which was dumping enormous amounts of water and, of course, building up the duck clubs. We were instructed by this large landowner to go to the duck clubs and collect the fees for the work we had done. Considering the size of the company, they probably felt that they had a little too much power and we would be cowed by it. Several of us got together and decided we were not going to abate this nuisance at the expense of the other taxpayers. This was a continuous nuisance requiring equipment and men on an almost daily basis for extended periods. We didn't go out to this big landowner, but instead asked the general manager of this corporation to come in to our board meeting. We just explained the situation to him, and ever since then, which was 9 years or so ago, they have been very cooperative.

As a board we naturally have other functions. We of course must approve the budget. The assessed valuation of our district is about $1,480,000,000 and we have a tax rate of 0.0093, which is less than a penny, and a buget of $140,500. Out of this budget we have a $10,000 unappropriated reserve fund for emergencies; the county treasurer invests this for us so it draws interest. Then we have another $10,000 general reserve fund to defray expenses between the beginning of the fiscal year and the time of distribution of tax receipts. I suppose we are a little spoiled in our district. Actually our manager does all the preliminary work on this. He recommends to us what is needed or what should be done and we discuss the matter so that it is clearly understood. If it is something serious the president may appoint a committee to investigate and report back to the board; then the matter can be acted upon officially.

I hope this brief review of some of the internal operations of the Orange County District has provided some helpful suggestions to some of you. I shall be happy to try to answer any questions that may occur to you individually. Thank you.

CASUALTY INSURANCE

ROBERT TYLER
President, Board of Trustees
Ballona Creek Mosquito Abatement District

I have been asked to discuss the general subject of casualty insurance or, as I prefer to identify the subject, the liability that the districts and their officers and employees have to the general public and how they can best protect themselves against that kind of liability.

We must go back to the English Common Law if we want to determine what was originally meant by sovereign immunity. This is still important because the Supreme Court of California and our Legislature are once again reviewing the subject of sovereign immunity. The English Common Law stated that the king could do no wrong and that the servants and the messengers of the king, while engaged in royal business could do no wrong and, therefore, there could be no suits against the Crown. That basic premise was carried over into the American colonies, and again by the various states as they were admitted to the Union, and finally by the State of California. Thus the theory of sovereign immunity has prevailed here in California through the years.

In recent years, however, there have been some breaches made in this concept of sovereign immunity. At the present time in California there are several areas where the state is considered subject to liability. The general principle, however, still holds that any state employee, including employees of your mosquito abatement districts, engaged in properly defined governmental activities is free from suit.

There is another kind of activity that some types of districts or governmental units can be engaged in, which is known as a proprietary activity. They may, for example, operate a municipal power plant. There they can be held liable right down the line. We need not be concerned with this, however, since none of our mosquito abatement districts are engaged in proprietary activities. They are engaged exclusively in governmental activities, as has been determined in a special opinion from the Attorney General.

As I said, there has been a tendency recently to breach this immunity of governmental activities. One specific case concerned with the creation of a nuisance resulted in a suit involving a mosquito abatement district. The district was sued because of an accident which occurred as a result of the nuisance which was created. This case was decided by the California Appellate Court, which held that the control of mosquitoes by a mosquito abatement district is a governmental function from which the district is immune from liability—except where the district is engaged in maintaining a nuisance. Where it can be shown that the district is guilty of maintaining a nuisance, the district and its employees are liable. In this particular case, two district employees were operating a jeep and trailer on private property near a public highway. They released a chemical fog intended for a field infested with mosquitoes. Instead, the fog drifted onto a public highway for a distance of some two hundred yards. At this point the fog enveloped the plaintiff's automobile, reducing the visibility to 3 or 4 feet. She decreased her speed and attempted to drive off the road but before she could do so her vehicle was struck from the rear and the motor stalled. She told her two granddaughters who were riding with her to get out of the car and seek a place of safety. Before she was able to get out of the car, the two grandchildren disappeared from her view into the fog. She heard them screaming and left her car and stepped between the rear of her automobile and the vehicle which struck her car. While she was there a second car struck the rear of the first vehicle, moving it forward and pinning her legs between the front end of the moving car and her own automobile. Before she could be removed a third car hit the second, resulting in additional injury. She sued the district, the trustees, the manager, and the employees. The court in this case ruled that when a condition was created which resulted in blanketing the highway with fog, thereby reducing visibility drastically, this constituted a nuisance and the district, its officers, its trustees and its employees could be held liable for this nuisance and the injuries to the plaintiff resulting from it. The court also ruled that the district and its officers, trustees and employees could be held liable for negligent operation of a motor vehicle by reason of the special liability statute set forth in Section 400 of the California Motor Vehicle Code. It is advisable, I think, for us to take notice of these two statutes because they are the ones which primarily concern our liability.

Section 3479 of the California Civil Code reads: "Anything which is injurious to health or is indecent or offensive to the senses or an obstruction to the free use of property so as to interfere with the comfortable enjoyment of life or property, or unlawfully obstructs the free passage or use in the customary manner of any navigable lake or river, bay, stream, canal or basin, or any public park, square, street or highway is a nuisance." That covers quite a bit of territory. In the case just mentioned the court gave the further opinion: "We are satisfied that a thick blanket of chemical fog making it impossible for motorists to see or proceed safely down the highway is a nuisance within the meaning of said Section 3479."

Section 400 of the Vehicle Code which provides that every district established by law is responsible to every person who sustains any injury as the result of negligent operation of a motor vehicle. The court in this same case again held that the jeep with trailer attached was a motor vehicle under this statute and that if it were operated negligently there was liability, even though the operation was not on a public highway as was true of this case.

It is my understanding that the judgment went back from the Supreme Court to the district, that the district's insurance carrier finally settled the case out of court, and that there was no second trial.

As a result of this case we see that a district can be held liable for the operation of its motor vehicles and equipment and that this law of liability extends to the officers, the employees, and trustees of the district. Since the district can also be held liable for creating a nuisance, we have to go back in each case to the statute cited to see if the operation in question

comes within that definition. It is easy to see that there can be many situations where a nuisance might be created by the employees of a mosquito abatement district—in spraying, clearing water channels, obstructing water channels, cutting down weeds, or leaving obstructions and refuse in places where they might cause injury to third persons, to sight but a few examples. Thus, in reality there is a wide range of liability in which the district might be held.

The question now becomes one of how best to protect the districts, their officers, trustees and employees against suits which might result in serious financial loss to the district or to the individual employees. Considing first the matter of public liability and property damage in the operation of motor vehicles, I am sure every district is covered by that type of insurance. However, in this day of large jury verdicts and judgments, it is wise to obtain the highest possible limits of public liability. I would think that $250,000 for accidents involving one person and $500,000 for accidents involving more than one person would certainly not be any too much to carry. I think we should also carry the maximum limit we can afford of property damage insurance. Your insurance broker should be competent to guide you in determining adequate coverage. If he is not, change brokers. This coverage should include not only the employees themselves but also the officers and the trustees when they are driving on district business.

There is of course a wide range of possible liability under the nuisance statute and we cannot hope to use auto insurance to cover all of these situations. I think the best insurance is a comprehensive general liability policy (not the comprehensive personal) and in that policy you should include products liability.

As time goes on the insurance people may find that you are engaged in additional activities, or what they call additional exposures. When that happens they make an audit, add that additional exposure to your liability, and raise your rates. The rates are higher than in what they call a schedule policy. A schedule policy lists the specific things for which the insurance company holds itself liable and if what happens isn't on that list, you get nothing. That is not a safe policy in my opinion for an agency which is engaged in as many varied activities as our districts are. I think you need a comprehensive general liability policy. This covers all exposures, listed or not, with the certain exceptions I will note. You should, however, elect specifically to include products liability. Then I think you have the best coverage that the insurance companies offer at this time.

There are certain things that even the comprehensive policy does not cover. One is the use of boats and water craft away from the premises. If the boats are over 10 horsepower in certain instances or if they are over a certain length, you must have marine insurance. If you are using boats you had better check on this. Aircraft, of course, are not covered in the general comprehensive. Also, the use of automobiles is not automatically included in your general comprehensive policy. Most brokers will arrange it so your automobiles are included; this is ordinarily the best arrangement.

(Editor's note: The recorded discussion which followed was not clear enough to be transcribed.)

FOURTH SESSION (CONCURRENT)

TUESDAY, JANUARY 29, 1:30 P.M.

DAVID E. REED, *Presiding*

PANEL: SOURCE REDUCTION

FRED A. COMPIANO, *Moderator*

EXPERIENCE WITH DISTRICT-OWNED SOURCE REDUCTION EQUIPMENT

MAURICE V. BROWN
Kings Mosquito Abatement District

The Kings Mosquito Abatement District initiated its source reduction program in 1956, and from this beginning we finally reached the point of launching a program based on district-owned equipment this past season. Since the original position of the District Board of Trustees was to place full responsibility for correcting mosquito sources on the landowners, for some time it was felt that utilization of district-owned heavy equipment on private property would be contrary to this policy. During the past few years, however, the attitude towards the use of district-owned equipment has changed completely. In 1956, the district employed its first source reduction specialist. His principal responsibility initially was to summarize and evaluate treatment costs. The district then formulated a policy to provide for farmer contact, with the objective that of correcting mosquito sources through an educational approach.

During the first phase of our program we would meet with the farmer and talk to him about this problem; he would then make the necessary corrections at no expense to the district. In the second phase, the Soil Conservation Districts established an equipment program, the equipment being rented by farmers on a cost basis. In the third phase, equipment was rented by the district and operated by district personnel. The final and present approach is district-owned equipment.

(Editor's note: At this point the author showed a series of slides to illustrate the various approaches the Kings Mosquito Abatement District has used in source reduction.)

As I indicated, in 1958 the U.S. Soil Conservation Service entered into an equipment program which was beneficial to the district; therefore, there was no need for district-owned equipment because this would have been a duplication of the service within the district. In 1961, after four years, the Soil Conservation Districts dissolved their equipment programs. At this time our Board of Trustees authorized a survey to determine what privately-owned equipment was available within the district. From eight contractors contacted, 31 pieces of equipment were available. Only three of these were suited to our needs. We rented one of these units, a D-4 and a scraper and dozer.

At this time I would like to point out that contract equipment is something that should not be overlooked by districts interested in source reduction equipment. In our case, however, we found that equipment suitable to our needs was not always available for district use, as the contractor was engaged in commercial work as well as farming.

In 1962 the district purchased its own equipment which consisted of a TD9, a dozer, and a tilt-bed trailer. We rented a scraper. At the present time this is the extent of our source reduction equipment. Incidentally, the tilt-bed trailer was constructed by district personnel. Not only do we use our district equipment on natural problems, but we have constructed some dairy drains and have made the equipment available for use on tail water return systems.

During this short experience with district-owned equipment we have seen a decided improvement in our public relations effort with farmers throughout our district.

SUBSURFACE DRAINAGE SYSTEMS FOR MOSQUITO SOURCE REDUCTION

EDMOND PATTIMORE
Merced County Mosquito Abatement District

Subsurface drainage is used to lower the water table below the surface of the ground and to hold it at as constant a depth as possible. Subsurface drainage is accomplished by providing some type of water-carrying channels beneath the soil surface. This type of drainage has several agricultural benefits. The major benefits are:

(1) provides a root zone of greater depth (through more rapid soil aeration) thus making more plant nutrients and moisture available to the plants;

(2) allows the soil to warm up faster (More heat is required to raise a given volume of water 1° than the same volume of air.);

(3) improves the physical condition of the soil (granular structure developed and soil easier to work); and

(4) encourages the leaching of salts to reclaim and improve saline soils.

Mosquito abatement districts, particularly those whose major mosquito sources are agricultural, may have considerable justification to encourage this type of drainage system. A high water table extending to the soil surface will flood low areas which will serve as sources for mosquito breeding. Also, the knowledge of how these kinds of drainage systems work and why a sub-drainage system may be necessary can be useful to source reduction personnel in their public relations program.

A report of the U.S. Department of Agriculture Soil Conservation Service (Parsons 1960) describes a drainage survey in the west side of Merced and Fresno counties. This survey found that in this area at least 65,000 acres would benefit from subsurface drainage. There is probably also considerable area outside the survey boundaries which would be helped by subsurface drainage. The report concludes that, when incorporated with a proposed surface drainage system, subsurface drainage will be possible on some 52,000 acres that presently lack disposal facilities. The report also states that subsurface drainage will, by elimination of poorly drained areas, reduce the cost of weed and mosquito control.

Therefore, it may be well for mosquito abatement personnel to have an understanding of the principles involved in subsurface drainage and the factors considered in the design of this type of drainage system.

Subsurface drainage in arid and semi-arid areas.—Excess water requiring subsurface drainage in arid areas comes mainly from irrigation, although some ground water may be introduced from distant areas in some cases. Subsurface drainage is required here to lower the water table to a point where it will not interfere with plant development. The drains in arid areas are therefore set at a minimum of 5 to 7 feet deep. This lowers the water table and encourages the leaching of salts in the soil and irrigation water by removal through the subsurface drainage system.

Tile drains.—Tile drains are built from short sections of concrete or clay pipe, unsealed at the joints and butted together to form a continuous drain pipe. The tile drain system may be laid out in several patterns. The natural conditions of the area usually determine the pattern which can be used most effectively. Usually these take the form of grids, herringbones, or a grouping of intersecting mains and laterals. The two most important factors of design are the depth and spacing of the tile lines. The amount of water to be drained from the area must be determined, and the grade for the drain determined by survey. When this is done the size of the tile necessary can be computed.

The soil type will greatly influence the depth and spacing. In a sandy soil water can move more easily through to the tile as not much pressure is necessary to force this movement. The tile lines may be placed far apart and the water will not reach the surface. In a heavier soil, as more pressure is required to move the water through the soil, the tile lines must be closer together.

There are a number of ways to obtain information needed to develop a plan for a tile drainage system. (Ayres and Scoates 1939, Houston 1961). I would like to use as an example a procedure which was satisfactory in one case. In this instance a tile drain system was needed to service 80 acres of a 160 acre farm. The farm was bordered on three sides by large open drains. The first step to be taken was to determine the approximate amount of water passing through the soil and some measure of the rate of movement. This subsurface flow is subject to considerable variation. Several auger holes were made, to a depth of 8 feet, above the proposed tile lines. Several days after an irrigation the holes were examined and measurements were made of the water table depth. The holes were pumped out and the rate of flow into the holes was also measured. This was done several times over a four-day period. From the information obtained the following determinations were made. The hydraulic gradient (an indication of the force available to move water) and the hydraulic conductivity (conductivity through the soil in inches/hour) were calculated. Once a measure of the amount of water moving is established the flow of the area can be determined by the formula:

$Q = AKI$

A = Acres
K = Hydraulic conductivity
I = Hydraulic gradient

The size of tile needed is determined from the accretion of flow as the length of the tile increases. When the capacity of one tile size is exceeded a larger tile is added to the system. For this purpose one may use the tile drainage chart developed from the Yarnell-Woodward formula.

The spacing of the tile lines is determined from the level at which the water table must be maintained midway between the drains. Water will usually stand nearer the ground surface midway between the tile lines. Generally the deeper the lines are placed the greater may be the spacing between the lines. The calculations of the necessary factors are relatively straightforward using a tile spacing formula (Donnan Formula). For this particular design the depth of the tile was set at 7 feet, the grade at .003. With this depth the spacing of the laterals at 300 feet was considered to be adequate.

The tile drain system must have an outlet adequate to carry the excess water from the drained area. The outlet may be an open drain into which water flows by gravity from the tiles. If the tile is deeper than the outlet it may be necessary to pump the drainage into an open drain. The capacity required of the pump can be determined from the total flow of the entire tile system.

Once the depth, size, spacing and outlet are established the tile system may be laid out on the land. Stakes are then set and marked with the proper grade. The excavation and setting of the tile are done by ladder-type tile-laying machines. Finally, a suitable filter material, such as sand, is placed around the tile to prevent sealing of the lines.

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DUCK MANAGEMENT FOR MOSQUITO SUPPRESSION

GEORGE R. WHITTEN
Delta Mosquito Abatement District

Mosquito control is a very interesting field. In spite of the fact that we have been working in the field for more than half a century we are still pioneering. There are still many problems that need answers. The only way to find some of these answers is to try a new approach.

In the Delta Mosquito Abatement District one of our major problems is the house mosquito, *Culex pipiens quinquefasciatus*, and a major source of this species is the dairy drain. Dairy farmers in our district use approximately one hundred gallons of water per day per cow to keep their milking barns and holding corrals clean and sanitary. This liquid manure represents a difficult and continuing problem three hundred sixty-five days a year to the farmer and consequently to the district. In attempting to find a solution to this problem we have tried many different approaches.

One method which seemed to offer a satisfactory solution, both from the farmer's as well as the district's viewpoint, called for pumping this material directly from a small cement collecting sump at the dairy barn into the irrigation pipeline. This represents a solution in a limited number of cases. The success of this method is limited by the fact that this is a continuous every day problem and few farmers have the physical setup required to utilize or hold this material in their irrigation system long enough to make the system feasible on a sustained basis. The use of a holding or balancing reservoir makes any system more flexible, and consequently more acceptable to the farmers, because of the time it allows for cultivating, planting, and harvesting.

Any dairy drain reservoir will have to be sprayed for mosquitoes; however, we like to see properly constructed reservoirs where power equipment can be used to control the weeds and the mosquitoes, in preference to weed-choked swamps and ditches which require many hours of hand spraying with very uncertain results.

In developing a system to handle this liquid dairy manure, unforeseen problems do occur which require some rather unusual solutions. One such side problem has been plaguing us for several years, defying solution by ordinary means.

The first two years after construction of one of these holding areas, there is very little floatage problem. However, by the end of the second season enough solids have accumulated on the bottom to produce gas, which in turn brings these solids to the surface of the reservoir. Once the surface of this floating mass has dried in the sun the gas is trapped, and continued accumulation of organic solids and gas may produce an island up to 18 inches thick which will support a tremendous growth of water grass with some Bermuda grass and even cattails. These floating islands of manure and grass make ideal protected areas for mosquito larvae and getting insecticide to penetrate all the cracks and crevices is impossible. It is relatively simple to spray an open water surface and get 100% control, but where these islands cover anywhere from 10 to 90% of the surface area, extra time and insecticide must be expended and the results are not always satisfactory. Over the last two years we have tried breaking up these islands mechanically, treating the reservoirs with various spreading agents, and applying diesel oil and burning. All of these methods have worked, but all have been very costly and the results have been only temporary. It would take at least a once-a-month mechanical treatment or a once-a-week chemical treatment to do a barely adequate job of keeping the surface open so it could be sprayed. If we project this to the more than 100 dairies treated by the Delta District the job becomes impossible.

This particular field study which I am reporting on started quite by accident when I noted the feeding activity of a pair of wandering Mallard ducks on a dairy drain reservoir. They were very industriously chopping into these islands of manure and grass after either seeds or insect larvae. This seemed like a very constructive way for them to be spending their time.

Dairy drain holding ponds appear to be a natural environment for ducks. There is plenty of food in the form of waste dairy feed washed out of the milking barn, fly larvae, and worms of various kinds. (This brings up a question of how many mosquito larvae a duck will eat. Maybe this should be investigated. We might have a natural predator.) Mallards, even domesticated strains, apparently have enough natural instinct for survival that they appear well adjusted to this environment. Some of the domesticated species, on the other hand, do not adjust nearly as well, nor do they display the industrious behavior of the Mallards.

In order to investigate this phenomenon further, the next step was to implement the activity with more of the same. The Bureau of Vector Control has been very helpful in this endeavor. Don Womeldorf supplied us with popcorn bait impregnated with alfa chloralose, anesthetizing agent. This we feed to domesticated Mallards at our local park, with the blessings incidentally of Park Superintendent Merle Harp.

On June 1st we planted four Mallard ducks on the Frank Costa and Sons Dairy, clipping the feathers of one wing to assure their staying long enough to get acquainted with the area. They prospered, but four ducks were not enough to solve the problem. Since June, John Walsh, from the Bureau of Vector Control Field Station at Fresno, has supplied us on four occasions with additional anesthetic bait and helped collect and disperse 37 more ducks to the Costa dairy and seven other dairies on which floatage has become a problem.

Observing the results to date we find the Costa dairy about 80% cleared of floatage and the ducks fat and happy. At the other dairies that were stocked later there were some signs of improvement. We hope this will have progressed well by summer when our mosquito problem can be expected to become acute.

This looks like an economical, painless way to solve this floatage problem that has been plaguing us for more than two years.

HOW WE CAN IMPROVE OUR SOURCE REDUCTION PROGRAMS

FRED A. COMPIANO
San Joaquin Mosquito Abatement District

Perhaps the best approach I can take in suggesting improvements which might be made in source reduction opertaions would be to cite some examples from our district's cooperative approach to this phase of mosquito control.

Considering one of the more common examples, if we want to provide a farmer with sound recommendations for developing or improving a drainage system for irrigated pastures, we must first run an engineering survey on the project. On our major sources we take a cross section topographic reading and, in many cases develop a grid system. This is done after one or two preliminary discussions with the farmer; then when we return we have something tangible to talk about. From our experience, if you plan to approach a farmer to obtain corrective measures on a problem you had better be prepared to offer a practical solution. If you are ready to do the engineering and surveying, and come up with solid recommendations, the property owner will listen, and your prospect of completing a successful project is good.

Of course, agriculture isn't the only source of mosquitoes. In our district we estimate that approximately 70% of our sources are agricultural. We also have significant industrial and domestic sources, not to mention river bottoms and other natural sources such as dead-end sloughs that produce mosquitoes due to tidal action. These various habitats produce different species of mosquitoes and, beyond that, different agencies must be dealt with to complicate the picture further. For example, last year we put in a considerable amount of work along a natural stream. In such a situation we don't just move equipment in and say, "Well, we're going to fill up this borrow pit or block off this stream here," without first notifying the agency, or sometimes agencies, directly concerned.

We had an experience of this type involving the Reclamation District on Roberts Island. The elevation of the island is five feet below sea level so gravity drainage is imposible. Pumps are the only thing that will do the job. It was quite a revelation to learn how many different agencies were involved in this. In this particular case our first contact was with the directors of this Reclamation District. In many cases the directors of reclamation districts are mainly concerned with levee maintenance and perhaps providing water within the district. When it comes to filling or blocking off a natural stream, the problem often becomes quite complex. In this instance we also had to obtain approval from the Corps of Engineers, the State Bureau of Reclamation, and the County Flood Control Agency. We had to complete an engineering survey on the project before they could even listen to us, and this was not simple. It was necessary to determine both the bottom floor line of the existing level as well as the elevation of the borrow pit we were going to fill. This work takes time. Probably most mosquito abatement districts do not have personnel required to work all of these problems out and get the kind of information required. But if a district is to undertake such projects these things have to be done.

I might cite another problem we had in our district that may sound familiar to some of you. This concerned the elimination of a source of both mosquitoes and gnats at a winery. About three months before crushing season we were asked to design an intermittent irrigation system at this winery. Again, many considerations enter the picture. We needed help. This happened to be a project that involved $12,000 worth of work so we couldn't afford to make very many mistakes. This operation was new to our district so I first turned to the Wine Institute in Fresno for information and they were glad to provide it. We met at the winery and all kinds of ideas were brought forth and discussed; however, we were the ones who were expected to produce the plan since we were continually after the winery to eliminate this source.

After some three meetings the Wine Institute gave us approval to engineer the project on an intermittent irrigation basis. The first things we had to determine were the volume of water we were going to dispose of, the type of soil we were dealing with, and in particular the infiltration rates. This is often difficult to determine because you may have a soil that will take three inches of water per hour and a month or a year later it will take only one inch per hour. The Wine Institute wanted to set up some strip checks at an interval of 100 foot fall with a flat gradient from border to border; we wanted a 50 foot fall. This is the kind of situation where it is necessary to get together and come up with a mutually agreeable solution; after all, they are paying the bill. We went ahead and engineered this project and disposed of the ponds they had been using. During the past three years we have not had to do any mosquito control work on this particular problem except for some ditches that provided water to the intermittent irrigation check.

In our particular district we have some 22 species of mosquitoes; therefore we must have many different kinds of habitats around. So we often need help. Frequently we turn to the Bureau of Vector Control and their staff consultants have been very helpful to us. However, in many instances we must also contact the Corps of Engineers, the Bureau of Reclamation, our Health Department, and the Department of Public Works. Of course, they have their own problems and limitations. However, by this kind of cooperative planning we can usually come up with a solution to a problem.

An effective source reduction program is apt to take years to materialize. We have been in operation for about eight years and some of these approaches are just now beginning to take shape. It is a mistake to take a narrow viewpoint of source reduction. If you will take the initiative in developing necessary interagency cooperation, you will find that other agencies welcome the opportunity to help. But you have to bring the problems to them.

During the next year the Source Reduction Committee will be asked to come up with some new ideas, so we are anxious to keep informed on any new developments applicable to source reduction technology. You are invited to sit in on our meetings and to contact us

on any problem you have. We may not have the answer but we promise to give it careful thought.

I would like at this time to thank my panel, George Whitten, Ed Pattimore, and Maury Brown for their participation on this panel and for their cooperation during the year. We would also like to thank the managers of the various districts for the support they have given to the Source Reduction Committee.

PAPERS ON SIGNIFICANT NEW TECHNICAL DEVELOPMENTS

DAVID E. REED, *Moderator*

PRELIMINARY STUDIES OF THE EFFECTS OF ORGANIC POLLUTION ON MOSQUITO LARVAL POPULATIONS IN SALT LAKE COUNTY, UTAH[1]

JAY E. GRAHAM[2] AND IVER E. BRADLEY[3]

In 1962 the South Salt Lake County Mosquito Abatement District began a study to determine some effects of organic pollution of water on mosquito larval populations.

Inspectors for the district were required to collect a sample of larvae from each pool where they were found and to record the average number per dip, the pollution of the water and other data. The larvae were later identified in the laboratory. To determine the average number of larvae per dip, at least ten dips were required and many more were usually taken.

There are techniques available to determine accurately the degree of organic pollution in water, but these techniques require considerable time, equipment and specialized training and were not practical for the mosquito abatement district to adopt at this stage of the study. Future studies will require the use of these techniques. Estimates of the degree of pollution, based on observations of the water and a knowledge of the source and some of the contaminants added to the water, can be made. For example, wells and springs that are used for drinking water were regarded as having little or no pollution. Ponds formed from water used to clean mink sheds and containing large quantities of mink droppings were considered highly polluted as were ponds that contained large quantities of waste from slaughter houses or large quantities of untreated sewage.

Determining the exact degree of pollution by estimates is not possible, but a scale was devised to record approximations that might be useful for the study. Unpolluted water, or water that appeared to be unpolluted was recorded as 1. All pools recorded as having a pollution 1 in the study were either springs or wells. Pools that were highly polluted were recorded as 10. Intermediate degrees of pollution were recorded as intermediate numbers. This procedure for recording pollution is neither precise nor extremely accurate, but since large numbers of pools were sampled in the study, consistent patterns are regarded as reliable. In this study 4,341 pools were sampled.

Pollution is only one of many complex factors influencing mosquito larval habitats and other factors may mask the effects of pollution or otherwise give inaccurate impressions. For example, determining the degree of pollution of water containing larvae of *Aedes dorsalis* may be more a measure of the water available for irrigation of pastures than the influence of pollution on larval populations of this species. The effects of pollution on larval populations could also be exerted on the adult female in making a site either attractive or unattractive as an egg laying site and the location of a pool might determine whether or not eggs of a particular species would be deposited regardless of the degree of pollution in the pool.

The average number of larvae per dip was plotted against pollution (Fig. I) and the density of larval populations were found to increase as pollution increased. In comparing larval density and pollution, the original intention was to consider pollution as light, moderate and heavy, since these degrees of pollution could reliably be estimated in the field; but a consistent pattern was obtained using all 10 categories of pollution, and since large numbers of pools were sampled in each category except number 1, all degrees of pollution are included in the graph. The increase in larval density at pollutions recorded as 2 is regarded as a random fluctuation. There is no reason to believe that mosquito larval densities in pools of pollution 2 were greater than at pollution 3. A least squares regression line was applied to the data and the average increase in larval density per pollution category was found to be 0.76 larvae per dip and the increase from category 1 to category 10 was 260%.

The relationship of species to pollution was more obscure, but some relationships were apparent. *Anopheles freeborni* larvae were found in relatively unpolluted water. All of the more abundant species of mosquitoes in Salt Lake County were found in all degrees of pollution but not equally. When the average pollution of all spots was calculated using assigned pollution numbers, it was found to be 5.29. Following is a chart showing the average pollution in which each of the four common species were found both without other species of mosquito larvae being present and with other species of mosquito larvae being present. Also included are the number of pools used to compute the averages.

	Alone		*With Others*	
	Average Pollution	*No. of Pools*	*Average Pollution*	*No. of Pools*
Aedes dorsalis	5.45	706	5.49	325
Culex tarsalis	4.95	599	5.26	1,041
Culiseta inornata	4.96	1,396	5.37	1,202
Culex pipiens	6.77	77	5.98	387

[1] This study was supported in part by a National Institutes of Health Grant E3067(C2).

[2] South Salt Lake County Mosquito Abatement District, Midvale, Utah.

[3] University of Utah.

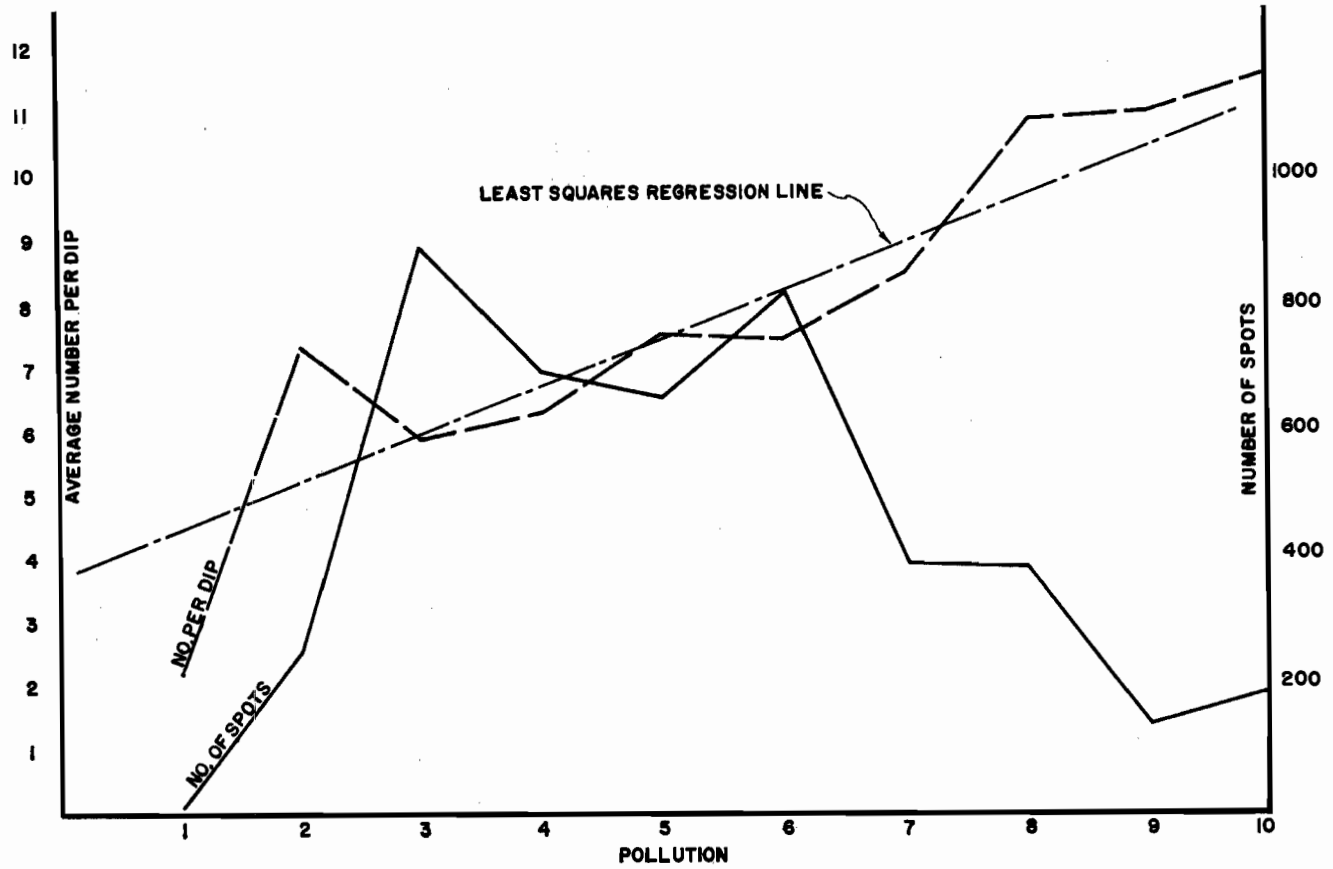

FIGURE 1.
The relationship of mosquito larval density to organic pollution of larval habitat in Salt Lake County, Utah. Higher numbers indicate greater pollution.

The frequency of occurence of each species in waters of different pollutions showed similar relationships.

SUMMARY AND CONCLUSIONS

In 1962 the South Salt Lake County Mosquito Abatement District began a preliminary study to determine some of the effects of organic pollution on mosquitq larval populations and to serve as a guide for more precise studies. Estimates of pollution were made for 4,341 pools and comparisons of pollution and larval density made. Some relationships of species to organic pollution were also determined. Increases in pollution caused an increase in the average number of mosquito larvae taken per dip. *Anopheles freeborni* larvae were found only in relatively unpolluted water. The more common species of mosquito larvae were found in all degrees of pollution, but *Culex pipiens* larvae were found more often in highly polluted waters and *Culex tarsalis* and *Culiseta inornata* larvae when found alone were in less polluted waters. The pollution of water containing larvae of either *Culex tarsalis* or *Culiseta inornata* with other mosquito species was not significantly different from the average pollution of all of the mosquito producing waters. A more detailed and precise study is necessary to obtain more accurate information on the effects of organic pollution on mosquito populations.

SUMMARY OF AIR CARRIER EXPERIMENTS WITH HIGH-EFFICIENCY FANS

NORMAN B. AKESSON AND MOHAMED NABIL EL AWADY
Agricultural Engineering Department
University of California, Davis

Operating characteristics of sprayer fans have been analyzed during the past four years by the Agricultural Engineering Department at Davis. Existing air-carrier devices were evaluated and new fans adaptable to small, jeep-mounted sprayers were investigated. The new fan designs were subjected to two basic criteria: 1) high-efficiency, permitting reduced horsepower and size; and 2) physical adaptability to mosquito sprayers.

Investigations by El Awady indicate that a moving air column carrying spray resembles an expanding cone with its apex at the fan nozzle and its base, the discharge front. A fan nozzle can be literally "coupled" to the cone at any distance downstream, starting from the apex, and the same-size cone of moving air produced. A fan coupled downstream obviously must discharge a greater volume of air at lower velocity, creating a favorable situation because less horsepower is required.

Fans on sprayers built in the Stockton, Modesto, Turlock, and Lodi districts are basically of high-veloc-

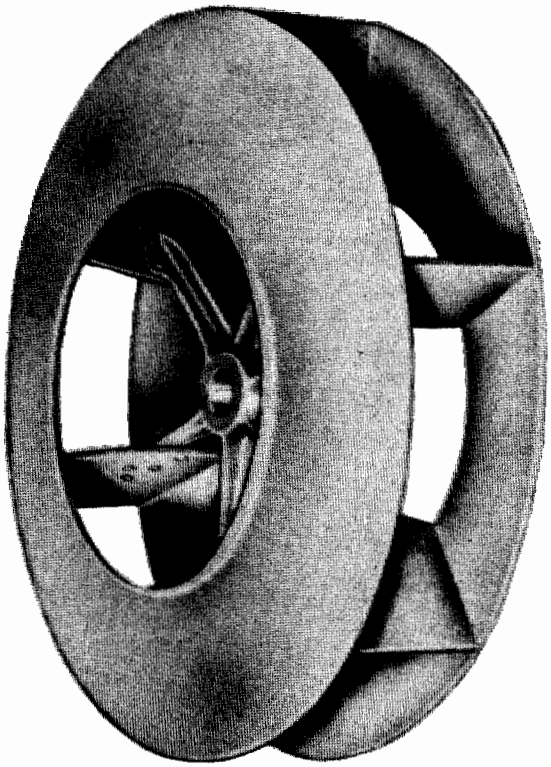

FIGURE 1.
Standard wheel (e.g., Stockton and Lodi units).

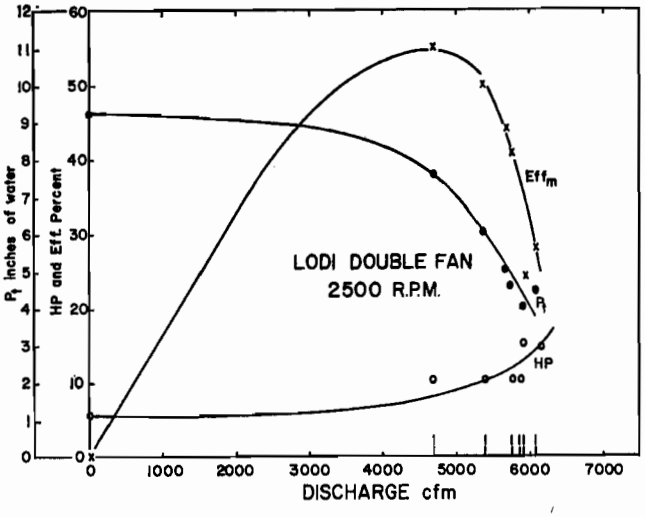

FIGURE 2.
Lodi fan (double type entry).

ity design, having 6-8 straight radial blades in a typical volute fan casing. When these fans operate with a static pressure of 6-12 inches of water (obtained by nozzling down the discharge) at 2000-3000 rpm, their efficiency rate varies from 30% to a maximum 60%. Figure 2 shows one of the most efficient designs, a Lodi double entry unit. However, maximum efficiency is impaired when the relatively high static pressure in the fan case is converted to a fast-moving air column of 100-150 mph discharge velocity. Conversely, if a fan provides maximum efficiency at a desired free air velocity of 70-80 mph, and functions of this unit provide the higher volume (4000-6000 cubic feet of air per minute) needed to couple it to the theoretical cone, efficiency can be substantially improved.

On this basis, various fans were examined for high-volume, low-pressure design. Propeller-type fans are traditionally high-volume, but do not adapt physically to the sprayer's needs. Squirrel-cage fans are designed for high pressure and hence are unsuitable. A compromise is effected by the backward-turned multi-blade centrifugal fan (Fig. 3) such as the Westinghouse Silent-Vane type.

The first trials were made with an older unit obviously designed for low-speed operation, probably under 2000 rpm; when run at 2500 rpm, the wheel collapsed inward and ruined the fan. A new fan was then purchased from Westinghouse (series 3000, 3016-DWDI class II), a multi-blade, double-entry unit capable of 3000 rpm. The wheel is 16½ inches in diameter, the total inlet area of both sides 3.65 sq. ft., outlet 2.808 sq. ft. Figures 4, 5 and 6 show the operating characteristics: Fig. 4 at 1500 rpm, air measured at the fan outlet; Fig. 5 at 2000 rpm, air measured at outlet; and Fig. 6 at 2000 rpm, air measured at duct. As the air measuring duct is 14 x 14 inches or 1.36 sq. ft., and the fan outlet is 2.808 sq. ft., efficiency losses resulted when air was forced into the duct.

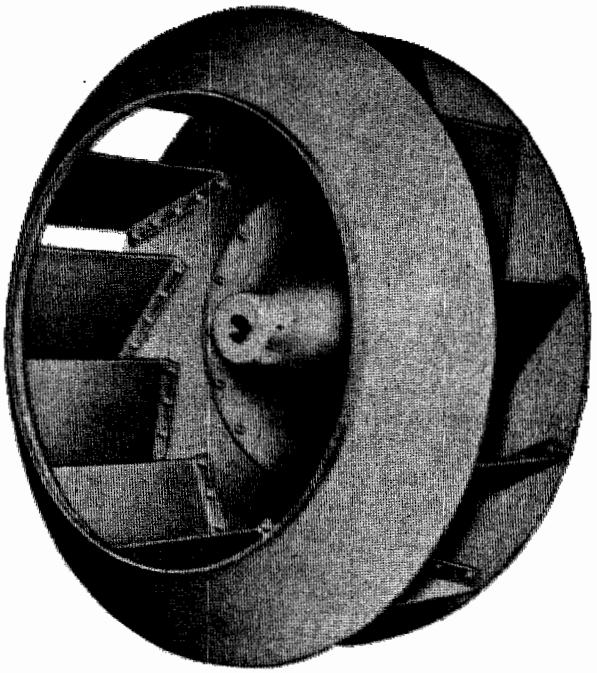

FIGURE 3.
Backward curved multi-blade type wheel (Westinghouse 300 series).

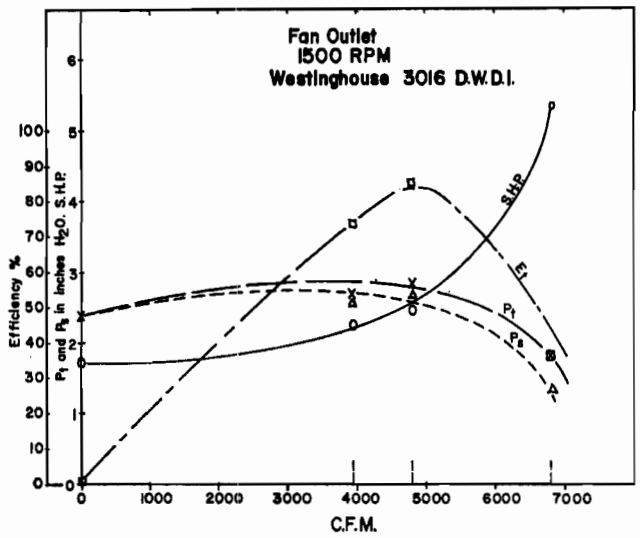

FIGURE 4.
Westinghouse 3016 curves (1500 rpm).

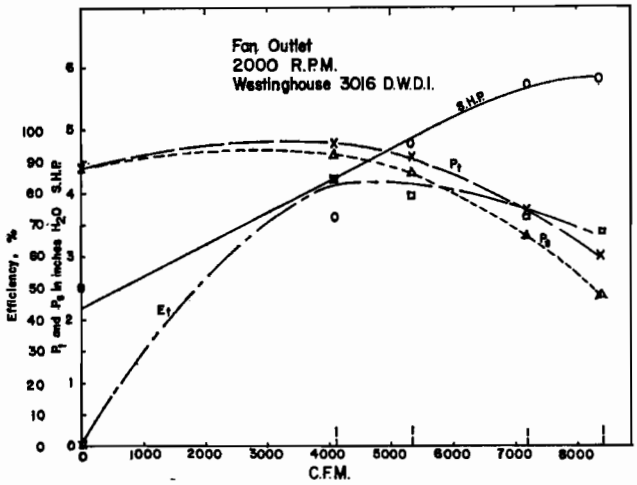

FIGURE 5.
Westinghouse 3016 curves (2000 rpm).
Air measured at fan casing.

The following table shows specific data from the maximum efficiency points on the Westinghouse fan. Air data are from the fan outlet.

rpm	*cfm*	P_s	*mph*	P_t	*HP*	*Eff.*
2000	4500	4.5	102	4.7	4.5	82
1750	5000	3.26	85	3.5	3.5	70
1500	4800	2.6	75	2.8	2.5	85

The next table compares the Westinghouse and Lodi fans, showing significantly higher efficiency for the Westinghouse unit.

	rpm	*cfm*	P_s	*mph*	*HP*	*Eff.*
Lodi fan	2500	4500	7.8	126	8	55*
	2500	6000	4.0	90	14	31*
Westing-	2000	4500	4.7	102	4.5	82†
house fan	2000	6500	3.5	85	3.8	60*

*air measured in duct †measured in outlet

If the Lodi fan is operated at lower P_t (total pressure) to simulate free air discharge at 90 mph, the efficiency rate drops from 55 to 31%, whereas the Westinghouse fan operates most efficiently at the lower pressures or velocities. Note the horsepower requirements: the Lodi fan at 6000 cfm and 90 mph required 14 horsepower; the Westinghouse at 6500 cfm and 85 mph used less than 6.

The Westinghouse fan and case cost about $350.00, the Lodi fan an estimated $150.00; but this cost difference would probably be offset by the cost of the driving engine. The weight of the entire unit should be less for the Westinghouse fan because of the smaller engine.

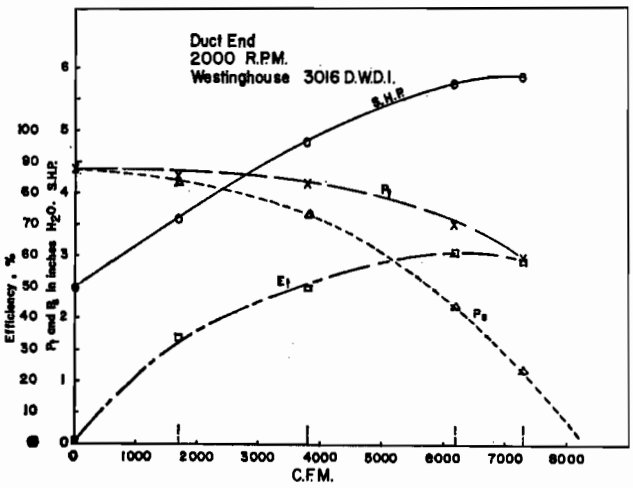

FIGURE 6.
Westinghouse 3016 curves (2000 rpm).
Air measured at duct.

In summary, although the more carefully designed units such as the Lodi sprayers are doing good work, a significant saving in weight (100-150 pounds) can be achieved by using fans such as the Westinghouse 3000 series that are better suited to the job. The two units (Lodi and Westinghouse) will perform equally well in the field insofar as air column and spray coverage is concerned. There is a definite advantage in using a higher-volume (4000-6000 cfm) air fan, which both of these are, instead of lower-volume (2000-3000 cfm) fans, because better spray patterns over wider swaths should be possible. El Awady will continue his work on spray carry as related to air column, and more information should be available in the near future.

THE PROBLEM OF DELUSORY PARASITOSIS (ENTOMOPHOBIA) IN ARTHROPOD CONTROL WORK

WILLIAM G. WALDRON
Los Angeles County Health Department

Arthropod control agencies which come into direct contact with the public are becoming increasingly aware of a unique emotional manifestation which has been known for many years as entomophobia (Pierce 1921). Actually, the generic term "entomophobia" denotes a "morbid dread of insects." This definition does not describe those persons who allege or imagine that they have an arthropod infestation on their bodies. Wilson and Miller (1946) and Obermayer (1955) have applied the term "delusions of parasitosis" or "delusory parasitosis" to those cases where the individual has an unshakable belief that live organisms, such as mites, or insects are present in (or on) the skin. In the past, the person with this problem has usually contacted health departments, universities, or museums. However, as mosquito abatement districts extend their interests into general arthropod control, it becomes increasingly probable that they will encounter the delusory parasitosis patient.

The first awareness of a complainant with a possible emotional disturbance may arise when the individual presents certain "specimens" to be identified. These "bugs" which allegedly cause "bites" and severe itching may be attached to plastic tape, in containers, or simply adhering to clothing. The person will usually request chemical control measures to get rid of the "infestation." The first responsibility of the arthropod control agency worker, as Gage (1957) and Traver (1951) indicate, is to make a thorough effort to find and identify the arthropod. There is a possibility that a genuine infestation is causing the problem. In most cases, however, the only things identifiable will be organic and inorganic debris, such as lint, thread, dried blood, or siliceous material. As Miller (1954) and Obermayer (1961) suggest, this time-consuming and sometimes tedious search for or identification of the arthropod (if it exists) is an important and necessary responsibility of the entomologist or arthropod control agency.

The patients apparently afflicted with delusory parasitosis often are eager to describe in detail every facet of their trouble to a sympathetic, albeit noncommittal listener. Discussion with the complainant usually discloses the following identifying types of information (Waldron 1962):

1. The "bugs" are black or white when first noted. Later on they may change color.
2. The "bugs" often jump. One person demonstrating this to the author was using a steel knife to prod the inanimate objects she thought were insects along a nylon slip which was stretched on a plastic sink top. The static electricity developed with this activity, of course, made the objects "jump." Unfortunately, the simple explanations which were made in an effort to describe this phenonmenon only sufficed for a short period of time.
3. The "bugs" may infest the patient's hair and can be shaken or combed onto a sheet, towel, or newspaper.
4. "Bites" which may develop on the skin usually itch and cause the person to scratch, even to the point of harsh tissue damage.
5. The "bugs" may come out of such common household items as toothpaste, vaseline, or cosmetics (Truxal 1961).
6. The supposed infestation in a home may become so severe as to literally force the person to move to another location. Unfortunately, the "bugs" usually appear in the new dwelling.
7. The patient may be so positive of his infestation and give such a lucid description that his family will stoutly support the contention even though they are not afflicted.[1]

Often the person will have attempted certain insect control measures himself. These may range from a cursory use of an aerosol spray to bathing in water to which DDT has been added. They may also use harsh soaps, detergents, or proprietary medications which sometimes aggravate their dermatological condition, causing event greater concern. The fact that they do not get rid of the "bugs" often may force them to hire pest control operators. In spite of the most ethical assistance of this type, the "bugs" usually remain.

One point of interest, and perhaps of some significance, is the fact that both Dr. Fred S. Truxal (1961), of the Los Angeles County Museum, and I have found that in most cases there had been an actual arthropod infestation prior to the onset of apparent delusions. This real infestation may have been the "triggering" factor in the appearance of delusions involving imaginary infestations. This particular phase of the problem, however, is strictly within the discipline of psychocutaneous medicine or psychiatry.

Often the people exhibiting the manifestations of delusory parasitosis will have been to a physician or dermatologist seeking an abatement of their condition. The physician in turn may direct them to an entomologist in an effort to identify the suspected arthropod. The patient in many cases does not go back to his doctor but will return again and again to the entomologist – each time with additional "specimens" to be checked. They may even go from one agency to another in a desperate attempt to gain relief from their "infestation."

One other possible manifestation of delusory parasitosis may concern aquatic Diptera, such as midges (Chironomidae) or shoreflies (Ephydridae). The complainant will definitely state that these innocuous bugs are mosquitoes and that they bite. Sometimes this, of course, is simply an excuse to try and force immediate action by dramatically over-emphasizing a problem. But there are also times when they really believe they

[1] Reproduced through permission of the Entomological Society of America.

have been bitten in spite of the fact that no mosquito or other biting insect is involved.

As Wilson (1952) states, delusory parasitosis is not only a very complex and difficult condition to correct but is also much more common than generally believed. Arthropod control workers attempting to aid these people must comport themselves with dignity and realize that these unfortunates are completely earnest. Their problem is very real and serious and the worker throughout his dealings with such individuals must be understanding, helpful and certainly very professional. Gage (1957) also advises that frankness with the complainant is often absolutely essential. Dr. Gage states, "If you do not find bugs, say so." Do not improvise with these people who may have a serious mental illness. However, the entomologist may be called upon to advise the person that his problem is not communicable to others. Just this bit of information may be some consolation. Where possible the patient should be directed for proper medical care. However, in many cases these people will refuse to seek further medical assistance.

Wilson (1952) has noted that very little work has been done on this particular emotional illness. It is my personal observation that very little study has been directed toward the position of the medical entomologist or the arthropod control agency and their responsibility to the person displaying the characteristics of delusory parasitosis. The agency often is not only inescapably involved in filling the need for identification of the arthropod, but also to some extent in the care and handling of the patient. Thus far, all progress in handling these kinds of cases appears to have been accomplished on an empirical basis. The success or failure of various approaches is therefore difficult to measure. It would appear that further investigations are necessary in order to define the problem clearly and to determine the proper role of public health entomologists and other lay workers who may on occasion be asked to provide consultation.

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THE PROSPECT FOR THE BIOLOGICAL CONTROL OF *HIPPELATES COLLUSAR* (TOWNSEND) IN SOUTHERN CALIFORNIA

E. C. Bay and E. F. Legner

Department of Biological Control, University of California Citrus Research Center and Agricultural Experiment Station, Riverside

Although the eye gnat, *Hippleates collusor* (Townsend), has been the subject of concerted study in the Coachella Valley of southern California for nearly four decades, it was not until 1958 that the first record of a parasite of this insect was obtained. At that time Mulla (1962a), while studying the ecological breeding niches of *Hippelates*, discovered a cynipoid parasite *Hexacola* sp. from soil recovered *Hippelates puparia*. Mulla reported that the degree of parasitism found did not exceed 5%. He concluded that the parasite did not seem to be an effective control agent of *Hippelates*, but suggested that the find might stimulate other work on the control of eye gnats by natural enemies.

Through the encouragement of Dr. Mulla and the assistance of the Coachella Valley Mosquito Abatement District such work was in fact started by the Department of Biological Control at Riverside in the summer of 1961. The project was undertaken somewhat reservedly for several reasons. Primary among these were (1) the contention that *Hippelates* as a group is native to the western hemisphere and, while still a pest, presumably is in equilibrium with the best of its natural enemies[1], and (2) the known fact that the immature stages of eye gnats occur subterrestrially, especially in cultivated soil. These considerations had in the past precluded the biological control approach for other workers.

After a brief, practical assessment was made of the technique to recover naturally occurring parasitized *Hippelates* puparia from the soil, the method was abandoned in favor of artificial host exposure. Whereas several hours of searching through concentrated detritus from soil washings and siftings had rewarded us with no parasitized individuals and barely more than a dozen unparasitized puparia, most of which had emerged, we were able to obtain several parasitized puparia from our first attempt at *Hippelates* host exposure. The parasites that emerged represented two species; however, only one of these was recovered alive. Our good fortune on this first occasion was more than could be hoped to last. Since that time many thousands of *Hippelates* puparia have been similarly exposed in a variety of habitats with a low percentage of rewards. Although the first parasite, *Phaenopria occidentalis* Fouts (Diapriidae), has not been found a second time, three additional species have been discovered. These include *Trichopria* sp. (Diapriidae), *Eupteromales nidulans* (Thomson) (Eupteromalidae) det. B. D. Burks, and *Spalangia drosophilae* Ashmead (Eupteromalidae). *S. drosophilae* was recovered twice, once from the Coachella Valley and once from the

[1] Recent reevaluation of publication by Becker (1911) indicates that *Hippelates* species may well be represented in the Eastern Hemisphere.

Palo Verde Valley. Mass releases of all of these parasites have been made, following which only *P. occidentalis* and S. *drosophilae* have succeeded in discovering host layouts.

We have yet to rediscover the *Hexacola* sp. found by Mulla. This may be highly significant because this parasite represents the only species so far to have been found in truly natural circumstances. However, *Hexacola* species are known to attack early instar dipterous larvae and then to develop with the host into its pupal stage. This explains why we were not able to collect *Hexacola* by our host pupal exposures.

Such is the summary of our attempts to date to assess the natural enemy control of *Hippelates* in southern California. Prospects for the biological control of *Hippelates* must at first seem as bleak as ever. Certainly no one should expect that the eye gnat problem will be completely solved by biological control in any case, any more than it has been by chemicals or cultural practices. However, through review of our own observations, together with those in the literature, we have constructed a hypothesis to guide our future research. This hypothesis is basically that *Hippelates* like other forms of Oscinidae are more dependent on living grasses than heretofore realized, and consequently may be more susceptible to natural enemy attack than previously assumed. This is not to refute the existing information concerning the saprophagous habit of *Hippelates*, but it is to suggest that disturbed sandy soil, although an important breeding site, is less prerequisite to *Hippelates* development than commonly thought. The observations which gave birth to this hypothesis are as follows, together with their significance and some supportive experimental evidence which has very recently been obtained.

Host Classification and Food Habits.—The genus *Hippelates* belongs to the family Chloropidae=(Oscinidae). The flies of this group are sometimes called frit flies or stem flies because the larvae of many species are known to feed on the stems of grasses. Some species, including *Hippelates*, are considered to be scavengers which feed largely on decaying vegetation and excrement. The eye-fly of India, *Siphonella funicola* de Meijere, is included in this group. In addition, a fly with similar habits reported by Cottam (1923) as *Oscinus pallipes* Lamb, which is elsewhere stated to be the synonymous with *Hippelates flavipes* Loew (Aldrich 1905), occurs near Khartoum in Egypt. Cottam (1923) attempted unsuccessfully to establish the natural breeding site for *O. pallipes*, while other workers (Roy 1928); Jepson and Pinto 1927; Remakrishna Ayyar 1917) sought to determine that of *S. funicola.* However, these workers did succeed in the laboratory rearing of both *O. pallipes* and *S. funicola* on rotting grass, rotting leaf mold, and horse and cow dung. The life cycles and developmental periods of these flies closely parallel those recorded by us and others for *Hippelates.*

Jepson and Pinto (1927) reared S. *funicola* on moistened blood meal in 16 days. They also tried rearing these gnats on a number of growing plants without success. They concluded that the natural medium for *Siphonella* larvae was probably decaying organic matter rather than growing plants common to Oscinidae.

Ramakrishna Ayyar (1917), while summing up his observations on *Siphonella,* commented that Williston (1908) had reported the larvae of this insect from the plant *Cirsium,* and that *Oscinus theae* is a leaf miner on tea in India. He concluded that "From these facts it is quite possible that the natural breeding haunts of the eye fly may be some common plant or plants. Further investigations will have to show this to be so or not."

Simmonds (1953), writing on *Oscinella frit* (L.) in Canada, states that although the European and North American flies of this species are morphologically indistinct, they are in habit very different. In Europe the preferred food of *O. frit* is said to be oats, while in America it is wheat. *Hippelates dissidens* (Tucker) and *H. particeps* were obtained in small numbers together with *O. umbrosa, O. coxendix* (Fitch), *O. neocoxendix* Sabrosky and *O. flaviscens* (Tucker) from wheat (?) in the eastern United States, but not from wheat plots at Belleville. This work by Simmonds has prompted us to suspect, as did Ramakrishna Ayyar regarding *Siphonella,* that it is possible that *Hippelates* normally infest certain living grasses not heretofore recognized as hosts. The investigation by Simmonds with *Oscinella frit* was concerned with seeking its parasites, and hisfindings give impetus to our theory. Simmonds discovered that a species of *Hexacola* parasitized up to 54.4% of *O. frit* larvae at Belleville, Ontario, and that *S. drosophilae* was by far the most important pupal parasite. It will be recalled that the parasite of *H. collusor* reported by Mulla was a species of *Hexacola* and that the most effective *Hippelates* pupal parasite found in our study is *S. drosophilae.*

Simmonds further observed that *Oscinella frit* laid its eggs mostly on the base of the wheat steam and in the coleoptile sheath of new shoots. This environment afforded the eggs protection from desiccation. Since *Hippelates* eggs have been found to take between 48 and 72 hours to hatch, and require considerable moisture, it has perplexed us that they should be able to survive the desiccating conditions of the Coachella Valley long enough to hatch if they are restricted to the soil surface. It seems logical that under natural conditions the eye gnat, like the frit fly, might select the protected humid microenvironment of a plant shoot for its oviposition site ,although the moisture of freshly tilled or freshly irrigated soil might otherwise be attractive.

The most commonly reported habitat of *Hippelates collusor* and *H. pusio* is cultivated loose sandy soil where a cover crop has been turned under (Herms and Burgess 1930; Burgess 1951; Bigham, 1941; Dow *et al.* 1951; Mulla 1962b). However, Mulla (1962b) reports that in addition to breeding in irrigated farmland which is tilled, eye gnats reproduce in certain nontilled areas. These include golf courses (especially those with new turf), and new lawns, ditch banks and canal shoulders, and alfalfa-barley fields. Furthermore, although Mulla concludes that it can be stated with reasonable certainty that the type of crop grown has no direct bearing on the extent and degree of *Hippelates* breeding, his findings show that he recovered more *Hippelates* puparia per unit area from alfalfa-

barley fields than from nearly any other source. Also it must be regarded that grass of some kind would constitute a common weed factor among all of the crops studied.

Spielman (1962) observed an increase in emergence of Cuban *Hippelates* 2 to 3 weeks after periodic rains in a nonagricultural semiarid area. He associated this with the ability of eggs of *H. pusio* and *H. impressus* to aestivate for up to one month, which he has demonstrated. Mulla (personal communication) attests to the ability of *Hippelates* eggs to endure limited aestivation. Although we are not familiar with the region where Spielman worked, we suspect that under the conditions which he described there should be considerable germination of new grass during periodic rainfall.

Recently we completed greenhouse investigations in which *H. collusor* deposited egg clutches within the leaf axils of young barley shoots 2 to 3 inches high, as well as on the surrounding damp soil. In later experiments we reared as many as 200 gnats in clean quartz sand where the only organic matter was in the form of ten living barley shoots nourished by hydroponic solution. The results of this test were positive in six out of six replicates.

It would appear that there is much evidence, both direct and circumstantial, to suggest that in some situations *Hippelates* may be quite dependent on living grass. This is not to refute that *Hippelates* thrive exceedingly well on decaying vegetation. Not only is this fact well established by the field investigations of many of the workers already mentioned, but we rely on its significance for the laboratory production of our *Hippelates* colonies.

Hippelates control attempts through the use of chemicals have proved discouraging due to the quantities necessary to achieve even mediocre results (Tinkham 1953; Dow and Willis 1959; Mulla *et al.* 1960). Tinkham (1951) strongly advocated cultural control through the practice of noncultivation, thus encouraging permanent stands of Bermuda grass. Mulla (1963) has confirmed Tinkham's findings and has found that control achieved in this manner is almost equal to that obtained by frequent tillage. Only herbicidal treatments gave superior control. Mulla suggested that in nontilled plots gnat larvae presumably obtain food from plant roots and residue in the soil.

If we can now assume that gnats are directly dependent on living grasses to a large extent, then we may presume that the first practice of noncultivation cultural control may imply the working presence of a reasonably effective complex of natural enemies. *Hexacola* spp., for instance, are generally known to attack first and second instar cyclorrhaphous Diptera which they detect and parasitize within the host stem. Similarly, since Mulla has shown that substantial breeding of *Hippelates* occurs in nontilled agricultural land, such as alfalfa-barley fields, it is likely as he suspects (1962b) that a higher percentage of pupae may be found exposed near the surface of the soil in those locations than in occasionally tilled land where the soil would have less cover. There is good evidence to support this belief. In our larval host exposures where we have placed containers of media in shaded locations, pupation has occurred near the soil surface. On the other hand, when we placed containers in full sun buried between rows of citrus, larvae pupated at the bottom of the containers four inches below the soil surface. Thus, in noncultivated vegetative stands it is to be expected that a higher percentage of pupae would be exposed to parasites such as *Spalangia drosophilae* and *Phaenopria occidentalis*.

The weight of information concerning the increased incidence of *Hippelates* about sandy agricultural regions is not without significance. Let us suppose that we have two undisturbed plots producing gnats at a uniform rate, with the gnats under satisfactory natural control. One plot has a loose sandy soil, the other a heavy loam. If we should turn under the vegetation in both plots, we must assume that with it we would be burying large numbers of immature *Hippelates* in their various stages of development. If the plots had been left undisturbed, it is reasoned that the natural enemies of the gnat would have prevented most of these now buried individuals from maturing. However, the buried hosts would enjoy not only protection from their natural enemies but also an expanded food supply in the form of buried leaf tissue in immediate association. Because of this, a greater survival ratio of egg to adult would be assured.

With respect to the character of the soil in the two plots, it is expected that buried gnats would have easier egress from a loose sandy soil than from a heavy loam, particularly if the latter had a tendency to crust. In testing this theory we have obtained 93% emergence of gnats from friable Coachella sand 4.5 inches deep and 65% emergence from the same sand 3 inches deep and water compacted, while only 38% emergence was obtained from loose damp Riverside clay loam at the same depth.

Although we acknowledge that the foregoing discussion is largely theoretical, the possibilities posed give hope for the prospect of the biological control of *Hippelates* in noncultivated areas. If the hypothesis proposed is proved to be true, then the realm of search for candidate natural enemies will be greatly extended. Although the genus *Hippelates* is believed to be relatively restricted in its distribution, related Oscinidae occur in many parts of Europe and elsewhere where they are reported to cause no serious annoyance.

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TASTE ORGANS AND THEIR ROLE IN THE FEEDING OF MOSQUITOES[1]

WILLIAM B. OWEN
University of Wyoming, Laramie

This report is based on a study of the morphology and physiology of the contact chemoreceptor organs of the female mosquito. Prior to this work little was known about the taste organs of mosquitoes and, especially, the role played by the sense of taste in feeding. Frings and Hamrum (1950) found evidence for taste receptors on the tarsi and labella and Feir, Lengy and Owen (1961) identified chemosensory hairs on the labella which were gustatory in function.

The species used in this research were *Aedes dorsalis* (Meigen) and *Culiseta inornata* (Williston). Many of the observations were made on living adults attached by their wings, as described by Feir, Lengy and Owen (1961). This type of mount was altered in several ways to meet special needs. An important modification was a new unsheathed stylets technique based on that of MacGregor (1930). Attached mosquitoes were observed with a stereomicroscope at 20 to 60 magnifications. Stimulating agents were placed directly on the tips of individual hairs with a micropipette supported with a low-power manipulator. Unstained whole mounts of tarsi, labella, ligulae and epipharyngeal sensilla were made on microslides for study with a phase contrast microscope.

[1]This investigation was supported by P.H.S. grant No. E-931 from the National Institute of Allergy and Infectious Diseases, Public Health Service.

RESULTS

Morphology of chemosensory hairs.—A tarsal hair bearing taste receptors arises from a socket, is curved, tapers gradually to a blunt tip and has two central cavities. These hairs vary in length from 26 to 52 microns. All labellar hairs of *C. inornata* over 32 microns in length are chemosensory. The longest of these are 80 microns. Each hair is socketed, tapers to a blunt tip and has two lumina. Studies in our laboratory by Zwonitzer (1962) have shown that each hair arises from a subcuticular complex of cells consisting of tormogen, trichogen and 3 or 4 bipolar neurons. The distal half of the ligula is covered with numerous hairs. Those known to be chemosensory are 23 to 37 microns long. A lagular hair tapers to a sharp point, has one central cavity and does not arise from a socket. Within the cibarium are two groups of sensilla: the epipharyngeal and, at the posterior end, four minute sensilla basiconica. Two types of epipharyngeal organs are present —delicate hairs and curved blunt spines. Both of these types of organs arise from sockets and are 8 to 10 microns in length.

Mosquitoes with ensheathed stylets.—Chemosensory hairs on the tarsi were identified for the first time. Stimulating a hair with 2M or 3M sucrose may elicit several different responses: the proboscis response; lateral movements of the proboscis; and bending the antennae forward. These responses were also evoked by stimulating groups of these hairs with water, maltose, fructose and glucose.

Placing a droplet of 1M sucrose on the tip of a labellar hair may elicit the fololwing: the labellar response; turning the labella to accept the solution; contractions of the pharyngeal pump; and the proboscis response. These responses were also evoked with water, maltose, fructose and glucose. Touching these hairs with fresh whole human blood and fresh heparinized blood elicited no acceptance reactions. Observations on females feeding on the arm of the investigator revealed no evidence of seepage of fluid where the stylets entered the skin, or that the labellar hairs were in contact with the skin puncture. The labella of *C. inornata* were held tightly about the stylets while probing and were often withdrawn from contact with the skin after beginning to suck blood.

The ligular hairs were exposed for study by removal of one labellum. Stimulating these hairs with sucrose may elicit three responses: the ligular response; the labellar response; and turning the ligula and labellum in an attempt to feed. Touching these hairs with fresh heparinized human blood evoked no response.

Mosquitoes with their stylets unsheathed.—Mosquitoes with unsheathed stylets were used to investigate the sensory control of feeding. In these experiments capillary tubes bearing test solutions were supported so that the mosquitoe's stylets could be inserted. Early in the study it was demonstrated that the stylets lacked taste receptors. This fact permitted an analysis of the

role played by the different taste receptors in experimental feeding. It was proved that taste receptors on the tarsi, labella and ligulae mediated aspiration. Thus, these receptors are essential in drinking water and the acceptance of sweet solutions, as well as other feeding responses. Spontaneous aspiration of an acceptable solution from a capillary tube was noted in some individuals. In this situation, sucking occurred in the absence of stimuli acting on the taste receptors. This suggests, and is supported by other evidence, that nongustatory stimuli can elicit sucking. Movement of fluids up the food channel of the labrum was controlled by altering the stimulus applied to the labellar hairs. The column of liquid could be driven one-half, two-thirds, or the full distance, as desired. Having induced a mosquito to suck an acceptable solution into the cibarium, aspiration was continued without further stimulation of the labellar hairs. If the tip of the labrum was then withdrawn from the solution for a few seconds, it was necessary to stimulate the labellar hairs to restore sucking. Unacceptable solutions were rejected when the mosquito was driven to aspirate them by stimulating the labellar hairs with sugar. Experiments of the above type provided evidence for the presence of taste receptors within the cibarium. It is assumed that the epipharyngeal hairs perform this function.

Feeding Behavior

All the data obtained in this study support the view that the feeding reaction of a female mosquito consists of two patterns: those responses associated with sucking blood and those exhibited while imbibing liquids, such as water, fruit juices and nectar.

Feeding on sugars.—When a hungry mosquito perches on a fresh slice of apple, the tarsal receptors mediate the proboscis response at once. This places the labellar hairs in contact with the apple, mediating the labellar response. Separation of the labella brings the ligular hairs in contact with the apple and the ligular response follows. Since chemosensory hairs on the tarsi, labella and ligula are all capable of evoking sucking, it is not known when the pharyngeal and cibarial pumps begin contracting. These responses could start with the first tarsal contact. The proboscis response brings the labrum in position to be placed in contact with the film of fruit juice. As this liquid is sucked into the cibarium, receptors in that area assume control of the sucking process. The hierarchy of command over feeding in this situation, in ascending order, is believed to be: tarsi, labellar hairs = ligular hairs, epipharyngeal sensilla.

Feeding on a host.—The normal feeding reaction on a host consists of: (1) attraction to the animal; (2) alighting; (3) probing for a source of blood; sucking; and (5) withdrawal of the stylets. The responses of the first three steps are elicited by visual, warmth and chemical stimuli (Laarman 1955, Brown 1956, Dethier 1957). There is no evidence that insertion of the stylets into the tissue and the initial contractions of the cibarial and pharyngeal pumps are mediated by taste receptors. Mosquitoes have been observed to probe (Roth 1951) and suck blood (Robinson 1939) after removal of the labella and ligula. After *C. inornata* has commenced sucking blood, severing the labium does not interrupt imbibement. Furthermore, mosquitoes probe and feed through the clothing of man without either the tarsi, labella or ligula coming in contact with the skin. These and other observations support the view that stimuli which attract a mosquito to its host and induce probing also elicit sucking. When blood is drawn into the cibarium, taste receptors at that level are stimulated to supply the sensory input to maintain sucking (Owen 1963).

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EFFECTS OF CARBAMATE INSECTICIDE SELECTION PRESSURE ON *ANOPHELES ALBIMANUS* WIED

G. P. Georghiou

Department of Entomology, University of California, Riverside

In meetings such as this, which concern people directly involved in mosquito control, the discussions inevitably drift to the problem of insecticide resistance. Since last year's meeting the situation in the field has not improved—it has actually worsened. By a recent count, 46 species of mosquitoes have developed resistance to dieldrin, or DDT or to both (Brown 1961). As you know these are the two materials on which the malaria eradication program is based.

The situation in the laboratory, however, appears to be brighter. New and more effective mosquito toxicants are constantly being synthesized, and some of

these are already on the list of candidate substitutes for dieldrin and DDT. In recent years there has been a keen interest in carbamate insecticides for mosquito control, stemming from the fact that certain of these compounds have demonstrated outstanding toxictiy to adult mosquitoes. It has been shown for instance, that *m*-isopropylphenyl methylcarbamate and certain related compounds are more toxic to *Culex quinquefasciatus* and *Anopheles albimanus* than DDT, dieldrin, parathion, malathion, and Baytex (Georghiou & Metcalf 1961).

Certain carbamates have also demonstrated prolonged residual activity (Gahan *et al.* 1961, Hadaway & Barlow 1962). It has been pointed out, however, that relatively high humidity is necessary for prolonged residual activity of carbamates on mud surfaces (Hadaway & Barlow 1962).

Past experience with DDT and dieldrin in mosquito control shows that the possibility of resistance, the speed with which it appears, and the levels it attains, are questions which must receive primary consideration in the choice of a toxicant. No report has yet been published on the question of mosquito resistance to carbamates. If we were to judge from our experience with the house fly we might suspect that resistance to these compounds in mosquitoes is a strong possibility. This is because in the house fly, resistance to certain carbamates develops at an unusually fast rate and to levels which render these compounds entirely ineffective.

However, the activity of carbamates in mosquitoes is peculiarly different than in house flies. Several carbamates which are highly toxic to the house fly are ineffective against mosquitoes and vice versa. To cite one example, the 3,5-dimethoxyphenyl methylcarbamate has an LD_{50} for house flies of 0.2μg yet it produces no kill on *Culex* or *Anopheles* larvae, even at concentrations of 10 p.p.m. On the other hand, the *m*-isopropylphenyl methylcarbamate, which is 10 times less effective against house flies than the previous compound, is extremely toxic to adult mosquitoes.

This specificity of activity is also reflected in the phenomenon of synergism by piperonyl butoxide. Many carbamates are synergized by piperonyl butoxide to a remarkable degree against house flies but very little or not at all against mosquitoes (Georghiou & Metcalf 1961). In addition, recovery from carbamate-induced knockdown is considerably more striking in house flies than in mosquitoes.

All these observations suggest the presence of distinctly different defense mechanisms against carbamates in mosquitoes, and prompted us to investigate the possibility and type of resistance which can be developed in mosquitoes by selection pressure with *m*-isopropylphenyl methylcarbamate (Hercules AC5727).

Two species of mosquitoes were used in these studies: *Culex pipiens quinquefasciatus*, from California, which has been reared in this laboratory for over 14 years without exposure to insecticides, and *Anopheles albimanus* the main vector of malaria in

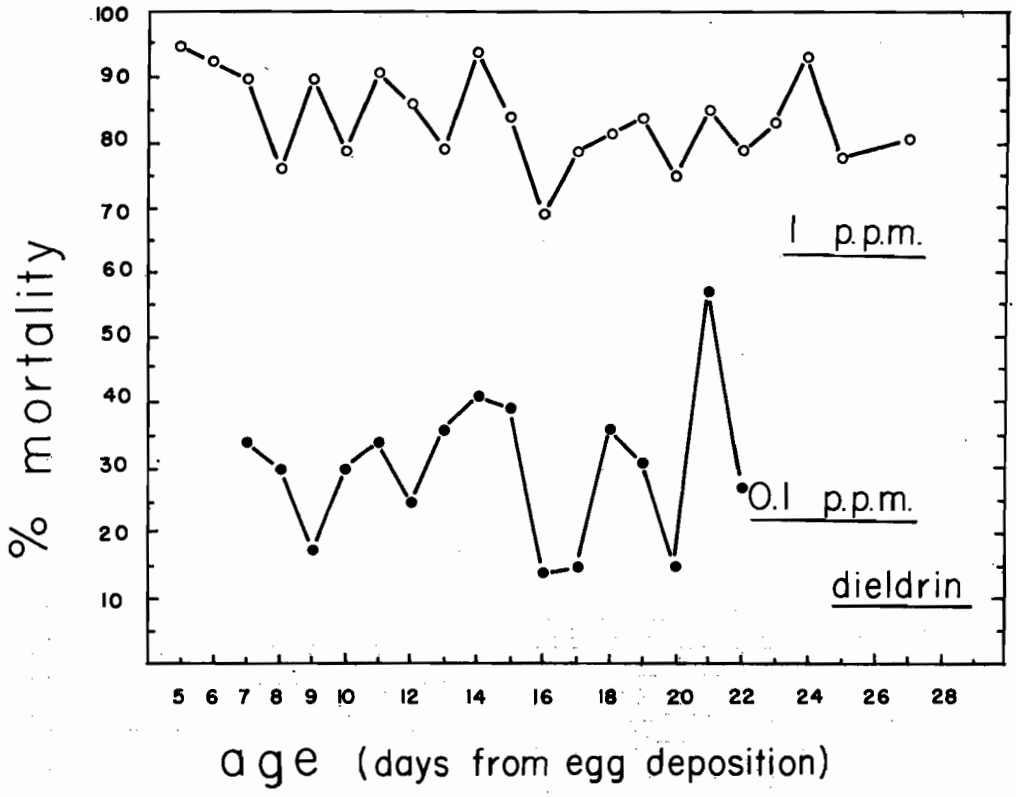

Fig. 1. Mortality of fourth instar larvae of *A. albimanus* treated with 0.1 and 1 p.p.m. dieldrin.

Central America. This strain presented a particularly interesting case for study since it was already resistant to dieldrin and also very tolerant to DDT. It is generally agreed that the time factor in the development of resistance is greatly reduced if the strain under selection is already resistant to another insecticide. That is one of the reasons for which we chose to use the dieldrin-resistant *Anopheles* for these studies.

In line with this, it may be interesting to mention that this strain has developed high resistance to dieldrin in at least 3 different laboratories without having been exposed to this insecticide. This is most unusual, although by no means the only such case. I mention this as a possible evidence of the rich genetic pool of this strain. When we began rearing this resistant strain in the laboratory, we noticed that the rate of development of the larvae was extremely variable. Some larvae reached fourth instar on the sixth or seventh day after hatching, while others did not until the twenty-second day and beyond. This was due in part to delayed hatching of some of the eggs. We suspected then that perhaps the factor for dieldrin resistance might be associated with the early- or late-developing larvae, so that if the procedure used in propagating the colony favored the resistant fraction, the colony would progressively acquire a preponderance of resistant individuals. However, when we treated fourth instar larvae of various ages with 0.1 or 1 p.p.m. dieldrin, we found that their susceptibility was independent of their rate of development (fig. 1) So much regarding the strains used in this work.

Our selection technique consisted of exposing fourth instar larvae of each generation to a concentration of the carbamate which would produce approximately 90% mortality within 24 hours. The surviving 10% were used to produce the next generation. Some 3,000 larvae were treated in each generation and the selections extended over 30 generations of *Culex* and 21 of *Anopheles* and are being continued.

The results presented in figure 2 show that we were able to increase the concentration of insecticide by a factor of only about two-fold, which is a very small increase indeed. Such increase is most likely a manifestation of vigor tolerance rather than an expression of specific physiological resistance. A similar increase was also shown by dosage-mortality lines obtained with the selective agent. Detailed LC_{50} data presented in tables 1and 2 indicate that the selected *Culex* strain shows a 5.2-fold increase in tolerance to Sevin, 2.3-fold increase in tolerance to AC-5727, but hardly any change toward the other carbamates and malathion. The same is also the case with *Anopheles*, which shows a 2.8-fold increase in tolerance to AC-5727 but no significant change toward the other compounds.

Toward dieldrin and DDT, *Culex* showed no change, but *Anopheles* lost a considerable part of its original resistance to these compounds.[1] It is noteworthy that an unselected check strain of *Anopheles* retained its resistance to dieldrin and DDT practically unchanged. This loss of dieldrin and DDT resistance in *Anopheles* during selection with the carbamate is interesting and potentially very promising. It may

[1] This is discussed in a paper prepared for publication elsewhere.

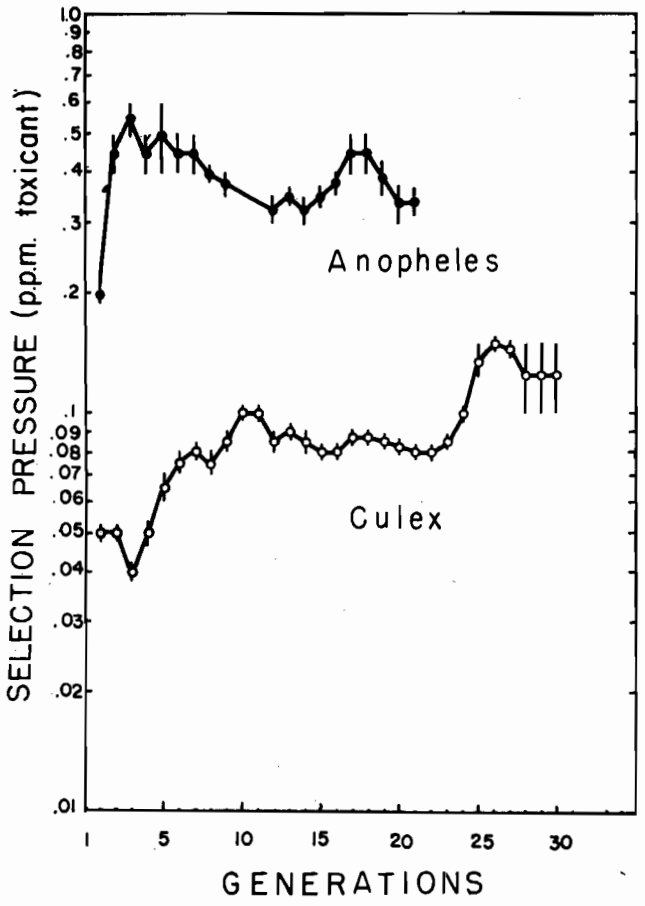

Fig. 2. Progressive increase in concentration of *m*-isopropylphenyl methylcarbamate required to produce about 90% selection pressure on *C. p. quinquefasciatus* and *A. albimanus*.

Table 1.—Larval LC_{50} levels (in p.p.m.) of *C. p. quinquefasciatus*, normal (P_1) and carbamate*-selected (F_{24}).

		P_1	F_{24}	$\frac{F_{24}}{P_1}$
N-methylcarbamate:				
m-isopropylphenyl	(AC5727)	0.04	0.092	2.3
o-isopropylphenyl	(B39731)	0.56	0.8	1.4
o-isopropoxyphenyl	(B39007)	0.35	0.56	1.6
m-sec-butylphenyl	(RE5305)	0.03	0.04	1.3
m-tert-butylphenyl	(RE5030)	0.15	0.22	1.5
4-methylthio-3,5-xylyl	(B37344)	0.23	0.24	1.0
1-naphthyl	(Sevin)	1.0	5.2	5.2
Malathion		0.08	0.1	1.3

* AC 5727

Table 2.—Larval LC_{50} levels (in p.p.m.) of *A. albimanus*, dieldrin-resistant (P_1) and carbamate*-selected (F_{17}).

		P_1	F_{17}	$\frac{F_{17}}{P_1}$
N-methylcarbamate:				
m-isopropylphenyl	(AC5727)	0.13	0.36	2.8
o-isopropylphenyl	(B39731)	0.46	0.5	1.1
o-isopropoxyphenyl	(B39007)	0.24	0.35	1.5
m-sec-butylphenyl	(RE5305)	0.13	0.11	0.8
m-tert-butylphenyl	(RE5030)	0.37	0.64	1.7
4-methylthio-3,5-xylyl	(B37344)	0.41	0.42	1.0
1-naphthyl	(Sevin)	0.62	0.78	1.3
Malathion		0.12	0.14	1.2

* AC 5727

mean that dieldrin-resistant *Anopheles* in the field may, after having been controlled for several generations with the carbamate, become again susceptible to dieldrin and DDT. We are currently investigating this problem further, being quite aware of its complexity.

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STUDIES ON THE BIOLOGY AND CONTROL OF CHIRONOMID MIDGES IN THE SAN FRANCISCO BAY REGION

R. H. Whitsel, C. A. Vickery, Jr., C. J. Rogers and C. D. Grant

San Mateo County Mosquito Abatement District, Burlingame, California

Various species of chironomid midges have become established as significant nuisance problems in San Mateo County and many other suburban areas throughout California. For this reason the District undertook a limited study to evaluate certain aspects of the problem two years ago. Extensive studies on midge populations and environment have been made throughout the world and many papers have been published on various species and their habitats. It is difficult however to apply these findings directly in survey and analysis of the many and variable problem sources and changing habitats of local midges for which control measures are being demanded of abatement agencies.

The San Mateo County District had necessarily recognized the need for and undertaken abatement measures on significant sources for several years. During this period it became apparent that efficient control required knowledge of the individual species, their biology and habitat, within these varied larval sources. This is becoming increasingly obvious as experience and knowledge is gained by agencies that are engaging in midge control. It is recognized that ecological and behavioral knowledge necessary for the control of such a great number of potential problem species will greatly exceed the yield of currently planned investigations. As a contribution toward meeting such an informational need, this paper sets forth data and observations for several specific study areas in San Mateo County wherein the species composition, larval abundance, and basic habitat factors were routinely recorded over a one year period.

Taxonomic uncertainties of many species of Californian midges have long been a deterrent to specific studies; recently, however, various workers have done much to remedy this problem and further contributions can be anticipated.

Acknowledgments

We are greatly indebted to Dr. James E. Sublette, of Eastern New Mexico University, whose identifications permitted the specific basis for these studies. Special thanks are extended to Dr. Joseph Hendricks, San Jose State College, for identification of snails, and to Mr. Edward O. Sampson, Vallejo Sanitation and Flood Control District, for the dissolved oxygen determinations at Lake Dalwigk.

Materials and Procedures

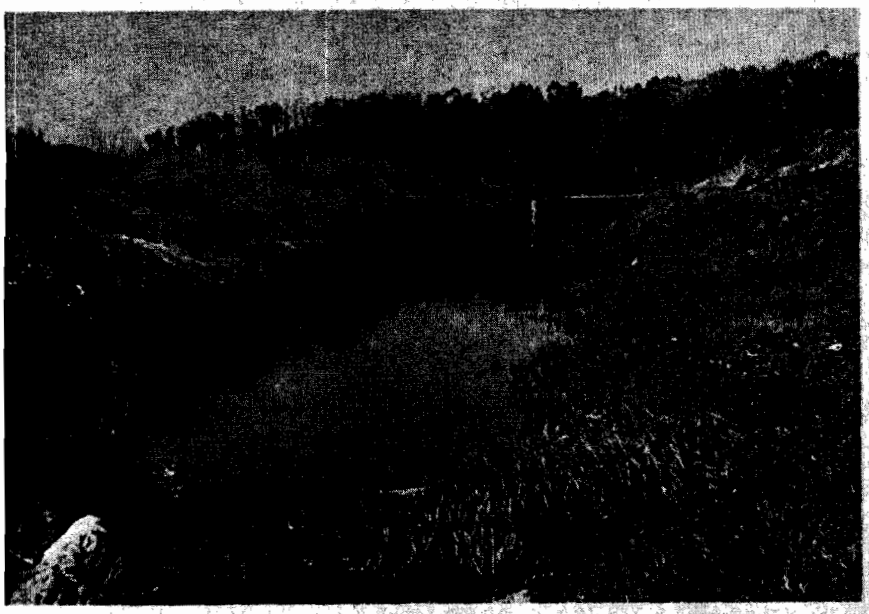
Because of the varied types of aquatic substrates to be sampled, a standard bottom sampler was not utilized. A brass cylinder 8 inches long with a 4-inch diameter was employed. The bottom rim of the cylinder bears a cutting edge. A sample is taken by placing a flat shovel horizontally through the base substrate at a depth of approximately 2 inches. The sampler is then placed on the shovel, rotating it if necessary to sever decumbent vegetation. The contents are carefully strained through a 28 mesh Tyler screen (0.589 mm. openings).

Adult chironomids were collected from 3 portable New Jersey type light traps placed in the vicinity of larval collecting stations or other known midge sources.

Water pH recordings were obtained, using a portable, glass-electrode Beckman meter (Model 180). Water temperatures were taken with a mercury thermometer (−10° to 110°C.) graduated to 1.0 degrees. The specific gravity of the water was taken as an index to salinity, and readings were made with a hydrometer (range: 1.000-1.220, with subdivisions of .002 degrees).

Individual laboratory rearing of chironomid larvae was accomplished in 8 dram vials. Water from the larval source was utilized even though fouling accounted for many unsuccessful rearings. Adults were

PLATE I

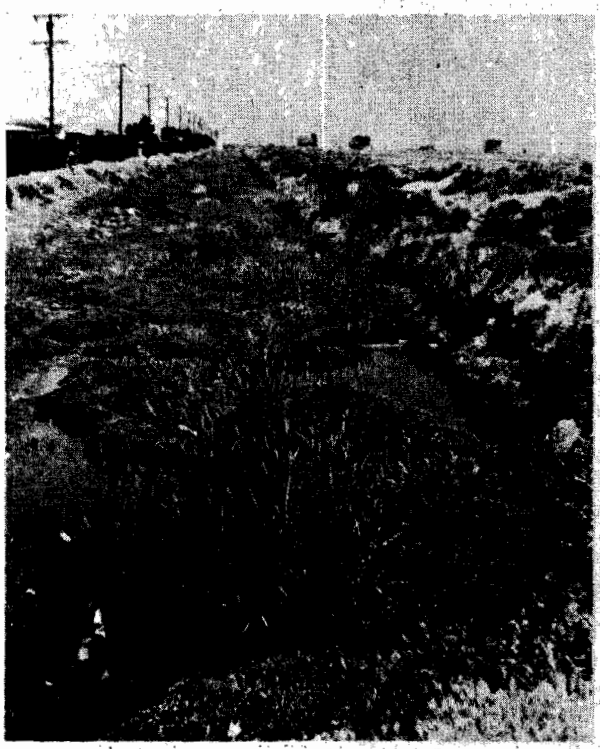


STATION 1.

Drainage channel from San Mateo Golf Course.

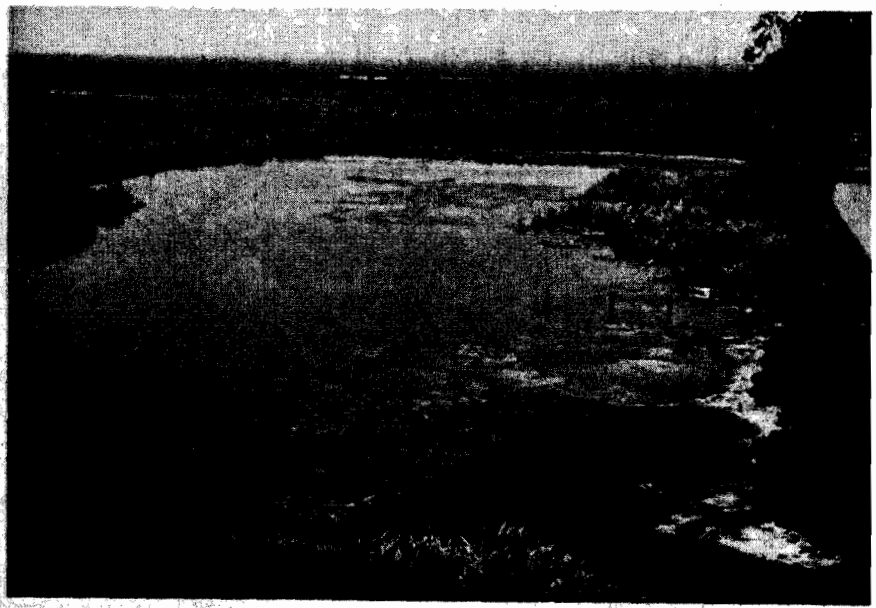
STATION 2.

Seepage pond from storm drain overflow.



STATION 3.

Laurel Creek near flood reservoir, San Mateo.



STATION 4.

Golf Course Lake at East Palo Alto.

reared during a six-month period at temperatures between 10°-18°C. during October, November, and December and between 10°-21° during January, February, and March.

Description of Study Stations.—For study purposes in evaluating midge biology and population potentials, a variety of persistent larval habitats were selected for continuous measurement and analysis over a one year period. Such sites were elected as representative of different common habitats constituting varied ecological conditions and previous evolution. Continuous study was eventually restricted to four such aquatic sources characteristic of the San Francisco Bay area. These stations are typical of numerous small but significant sources of chironomids which affect suburban and industrial areas, but do not include the benthic habitat of larger lakes and deep water sources.

Whereas all of the sources evolved into significant midge habitats within the last decade, some history of their evolution was known, thereby permitting some interpretation of findings concerned with species representation and population potentials. Midge production in all stations was preceded by a high increase in accumulated organic matter; however, each habitat differed in its potential modifying factors, resulting in different midge species composition, emergence patterns, and control needs. Most such sources experience a relatively rapid evolution during the year; the characteristics of a given source continually recur at new locations in our expanding suburbs.

Aquatic Station 1. Located in a drainage channel near Coyote Point, San Mateo. The land was reclaimed from salt marsh thirty years ago. It has remained undeveloped except for the installation of a proximal golf course, through which runs the water source for the drainage channel. The channel carries rain water run-off in winter, and in summer is fed by ground water seepage and sprinkling from the golf course. Water flow in the channel is usually slow, thereby permitting an accumulation of a deep deposit of organic ooze at the station site.

Range in water temperature, 8-28°C.; width 8-20 feet, depth less than one foot; range in water pH, 5.8-8.8; range in specific gravity, 1.000-1.004; bottom mostly a fine organic debris overlying a black ooze; slow flow; epiphytic diatoms present; filamentous green algae; *Lemna* in small mats; *Carex* along edge; no shade except for that afforded by cattails; brass buttons *(Colula coronopifolia)* abundant; snails *(Physa)* often over 125 per square foot; ceratopogonid *(Culicoides)* larvae and odonate nymphs abundant; Ephemeroptera, Plecoptera, Megaloptera, and Trichoptera absent; mosquito fish *(Gambusia affinis)* very plentiful.

Aquatic Station 2. A limited shallow seepage pond located next to the Bayshore Freeway near 19th Avenue, San Mateo, on flat marshland which was used as a salt collecting bed 20 years ago. Adjacent areas of salt beds have not been adequately altered to produce mosquitoes or midges, but this source has been repeatedly subjected to organically rich overflow from a storm drain, affording continuous water impoundage.

Range in water temperature, 3-23°C.; depth less than one-half foot; range in water pH, 6.8-8.0; range in specific graviety, 1.000-1.002 (after a rain, 1.006); bottom of organic debris and muck; epiphytic diatoms common; *Spirogyra* and *Oedogonium* present; cattails abundant; grassy edge; odonate nymphs prevalent; general insect fauna with little diversity.

Aquatic Station 3. A broad shallow creek bed (Laurel Creek) near El Camino Real at 40th Avenue in South San Maeo. The station site is at approximate mean tide level and the creek is drained by pumping into a terminal flood basin. Ten years ago the creek area was subject to tidal wash and negligible summer water flow. Subsequent to damming of the creek and urban development in its drainage basin, a constant but fluctuating fresh water supply is afforded without salt water flushing and with minimal water current. Mosquito and midge production began in this site almost immediately after closing it off from tidal action. This dam has been opened infrequently to permit entry of salt water.

Range in water temperature, 6-27°C.; width 24-30 feet; depth 1-2 feet; range in water pH, 7.7-8.8; range in specific gravity, 1.000-1.002 (one recording 1.008 when influenced by bay); bottom sandy with mud in backwaters; flow slow to moderate; little shade; algal streamers often present; oligochaetes and pulmonate snails numerous; common cattails, brass buttons, and water plantain *(Alisma plantago)* abundant; insect fauna poor.

Aquatic Station 4. A pond of about 75 by 250 feet located next to a golf course in East Palo Alto which was formed along with several others by excavations made for highway fill about 30 years ago. These pits were below ground water level and became significant mosquito sources as organic rubbish was introduced. Neighboring pits were used as a city dump and became excessively foul although the station site impoundment was excepted and mosquito control was effected by stocked *Gambusia*. Flooding in 1957-58 introduced large quantities of adjacent organic matter into this station, killing the fish and subsequently favoring extensive midge and cattail production, although no extensive organic solids were thereafter added. Enriched water from the sewage disposal plant was used to water the golf course and contributed to water impoundment at this site.

Range in water temperature, 6-26°C.; up to 5 feet in depth; range in water pH, 7.6-8.8; range in specific gravity, 1.001-1.016; bottom a black muck covered with decaying vegetation; good algal blooms occasionally present; a dinoflagellate *(Glenodinium* sp.) occasionally so abundant that the water appears reddish; scattered groups of cattails along the edge; oligochaetes, pulmonate snails, Hemiptera (notonectids), and Diptera (chironomids, ceratopogonids, syrphids) often very abundant; mosquito fish *(Gambusia affinis)* plentiful; insect fauna with few species.

List of Principal Pest Species Encountered

This list of midges includes only those species which on various occasions have adult densities high enough to be considered pestiferous. Species numbers where used are those assigned by Dr. James E. Sublette

Subfamily Orthocladiinae (Hydrobaeninae)
- *Cricotopus* species
- *Smittia* near *aterrima* (Meig.)

Subfamily Chironominae (Tendipedinae)
Tribe Chironomini (Tendipedini)
- *Tendipes (Tendipes) stigmaterus* (Say)
- *Tendipes (Tendipes) attenuatus* (Walker)
- *Tendipes (Tendipes) tuxis* (Curran)
- *Tendipes (Tendipes) atrella* Townes
- *Tendipes (Dicrotendipes) californicus* (Johannsen)

Tribe Tanytarsini (Calopsectrini)
- *Tanytarsus (Tanytarsus)* n. sp. 57

Discussion of Species Biology and Ecology

Orthocladiinae

Cricotopus species.—This group of midges is widespread on the marshlands. Several species are present, including *Cricotopus* sp. 12 and *Cricotopus* n. sp. 13. The former species appears to be prevalent during the autumn and winter months while the latter species generally is more prevalent from June through October (Table 1). The adults of *C.* n. sp. 13, largely males, are readily attracted to light.

Table 1.—Total number of pestiferous chironomid adults from three light trap stations, 1960-61.

	TRAP A		TRAP B				TRAP C		
Date	*Tendipes attenuatus*	*T. tuxis*	*T. attenuatus*	*T. tuxis*	*T. californicus*	*Cricotopus* n. sp. 13	*T. stigmaterus*	*T. tuxis*	*T. atrella*
Mar., 1960	72	0	11	0	0	0	0	0	58
Apr., 1960	70	0	8	1	0	0	0	0	87
May, 1960	49	0	6	0	0	0	0	2	274
June, 1960	4	0	133	0	6	26	0	2	92
July, 1960	1	2	27	21	3	6	5	12	238
Aug., 1960	0	6	41	27	0	39	0	14	61
Sept., 1960	2	0	45	27	0	109	4	7	84
Oct., 1960	2	0	33	58	0	30	0	0	30
Nov., 1960	1	0	10	0	0	0	0	0	7
Dec., 1960	2	0	1	0	0	0	0	0	0
Jan., 1961	0	0	0	0	0	0	0	0	1
Feb., 1961	34	0	2	0	0	0	0	0	4

The adults of *C.* n. sp. 13 began to appear in the light traps when the aquatic vegetation, primarily the green algae, was abundant in nearby sources. This species lives in silken tubes on aquatic vegetation, although some individuals may live on the bottom. Our observations indicate that two life cycles a year are common. This species was not taken by light traps during the cooler months, but was generally replaced by *Cricotopus* sp. 12. *Cricotopus* sp. 12 is not considered pestiferous.

Smittia sp. (near ***aterrima*** [Meig.]).—Larvae of this interesting species were extracted from the soil in the immediate vicinity of grass and *Erodium* roots. Tremendous numbers of adults were observed swarming in December 1961 after November rains. Adults were particularly evident on clear days when no strong breeze was present. Following a cool January, which brought about an inch of rain, a further examination of the soil revealed some larvae but few pupae. The numbers of adults steadily declined. During December 1962 few adults were evident, even after a heavy October rain. Occasionally, another *Smittia* species was observed to be associated with the *Smittia* sp. (near *aterrima)* when collected swarming or from vegetation.

Chironominae (Tendipedinae)
Chironomini (Tendipedini)

Tendipes (Tendipes) stigmaterus (Say).—The larvae of this species are prevalent at aquatic Station 1. Water known to be polluted with sewage wastes was found to have over 1100 larvae per square foot. Usinger and Kellen (1955) found this species in organic matter of sewage oxidation ponds. Larvae of this species were found to form cases on submerged vegetation such as pickleweed *(Salicornia).* A certain amount of salinity is tolerated, but the larval population is markedly reduced when the specific gravity recordings exceed 1.012.

This species is frequently associated with *T. atrella.*

Less than 1% of the Chironomini collected in light trap C (Table 1) are *T. stigmaterus.* Adults are generally abundant from April to October, but are apparently not readily attracted to light. The rate of development of *T. stigmaterus* larvae seems partially dependent on the time of the year, as with other *Tendipes* species. A third instar larva was held in the laboratory for 35 days before pupation during November and December (1960) where temperatures were consistently held below 18°C. Rearing of *T. stigmaterus* from egg to adult was not accomplished.

Tendipes (Tendipes) attenuatus (Walker).—This species is present at Station 2. Adults are generally present in variable numbers from March to November (Table 1). This species is widespread and readily attracted to light, particularly the males. Darby (1962) relates that a greater number of males than females of this species were collected in emergence traps.

The larvae seem to prefer an environment similar to that at Station 2 where fine ooze rests on the upper 2 to 3 inches of the bottom. Submerged plant parts, particularly the common cattail, in the process of decay were frequently a chosen substrate of these larvae for the establishment of their silken tubes. Plankton and detritus is readily available as food and for the construction of tubes.

It appears that two to three generations of this species are possible during the warmer months. The source of *T. attenuatus* to some measure determines the period of adult prevalence. Adults at light trap A are predominant from January through April as the source is intermittent. In contrast, those specimens taken at trap B emerge from a continuous source of running water. Normally the population is greatly reduced at trap B during the winter and early spring as a result of the increased water volume and turbulence in the creek.

A cursory examination of larvae from a water source may lead to ambiguity in larval counts since this species is occasionally associated with *T. tuxis* and *T. atrella*, with which it may be easily confused. In addition, clustering of *T. attenuatus* in microhabitats results in considerable variation in comparable samples (Gaufin *et al.* 1956). We have observed such variation with several species of *Tendipes*.

Reared adults were obtained in the laboratory from an egg mass 23 days after hatching where temperature ranged from 16-24°C.

Tendipes (Tendipes) tuxis (Curran).—Larvae of this species have been reared to adults from Station 2. Adults were occasionally taken from vegetation adjacent to the station. Adults are prevalent during the warmer months of the year when they are moderately attracted to light (Table 1). In light trap collections there are frequently twice as many males as females.

It is doubtful whether more than two generations are completed during the season. The developmental rate of third and fourth instars appears to be about that of *T. attenuatus*.

The larvae occur in habitats similar to those of *T. attenuatus* and *T. atrella*. *T. tuxis* was not successfully reared from egg to adult.

Tendipes (Tendipes) atrella Townes. — Adults of this species have been reared from second, third and fourth instar larvae taken from Station 1. Adults were prevalent from February through October and were readily attracted to light (Table 1). Adults often appear early in the year along with *T. attenuatus*. Of the 936 *T. atrella* adults collected at light trap C (Table 1), 204 (22%) were females. This species, like *T. stigmaterus*, is not so widely distributed as *T. attenuatus*, but may occasionally be very abundant.

Rearing adults from eggs was not accomplished, but many third and fourth instar larvae were carried to the pupal and adult stage in the laboratory. Two third instar larvae collected at Station 1 on October 26, 1959 did not emerge until January 8 and January 25, 1960. Another pair of third instar larvae collected on November 19, 1959 did not emerge until March 8 and March 17, 1960. These and other examples of emergence during the winter, when temperatures in the laboratory were consistently held below 21°C., indicated that emergence was greatly influenced by conditions within the individual rearing vials.

Tendipes (Dicrotendipes) californicus (Johannsen).—The larvae of this species were present in limited numbers at Station 3 in association with *Anatopynia venusta*. Although fairly widespread *T. (D.) californicus* is not common on the marshlands and was found to be most abundant in creeks, especially where a rocky substrate has a heavy growth of algae, such as *Cladophora*, and other submerged aquatic vegetation. Darby (1962) reports larvae present in mud samples and on submerged vegetation as a preferred habitat in rice fields. Whitsel (1962) noted an increase in the number of *T. californicus* in emergence traps in Coyote Creek (San Jose, California) as a direct result of additional submerged aquatic plant growth.

Adults were observed in the field from March through October. Adult populations vary considerably from year to year depending largely on the conditions of aquatic sources. During 1960 few adults were taken in the light trap at Station B; however, previous to and during the same period in 1961 a greater number of adults is evident for this station (Table 2).

TABLE 2. Number of *Tendipes californicus* adults trapped during two seasons

	1960				1961			
Sex	April	May	June	July	April	May	June	July
Male	0	0	5	3	2	11	14	41
Female	0	0	1	0	0	4	11	14

Tanytarsini

Tanytarsus (Tanytarsus) n. sp. 57.—The larvae of this species were present at Station 4, which was frequently highly saline. Specific gravity readings, as high as 1.016 at this station and in Seal Slough (San Mateo) indicate that larvae are capable of withstanding marked salinity. On November 2, 1960, when a dense adult population of this species (not confirmed by Dr. Sublette) was emerging from Lake Dalwigk (Vallejo) the specific gravity was 1.014. Dissolved oxygen determinations for this lake for a two month period prior to this emergence appear in Table 3. It is suspected that water samples taken near the bottom ooze and mud at a depth of 2-5 feet, rather than from shore sta-

TABLE 3. Dissolved oxygen recordings in p.p.m. for a two month period at Lake Dalwigk in 1960.[a]

Date		Sampling Points		
		A	B	C
September	1	7.9	4.1	6.9
	7	8.9	4.5	8.6
	13	8.3	3.2	7.0
	20	9.1	7.9	11.0
	29	----	4.3	4.7
October	6	7.2	5.1	----
	13	13.6	7.0	8.4
	20	10.5	6.0	11.2
	28	10.9	6.3	10.0

[a] Water samples collected from 10-11 a.m.

FIGURE 1.
Total number of adult chironomids of two subfamilies from three light traps, 1960-61.

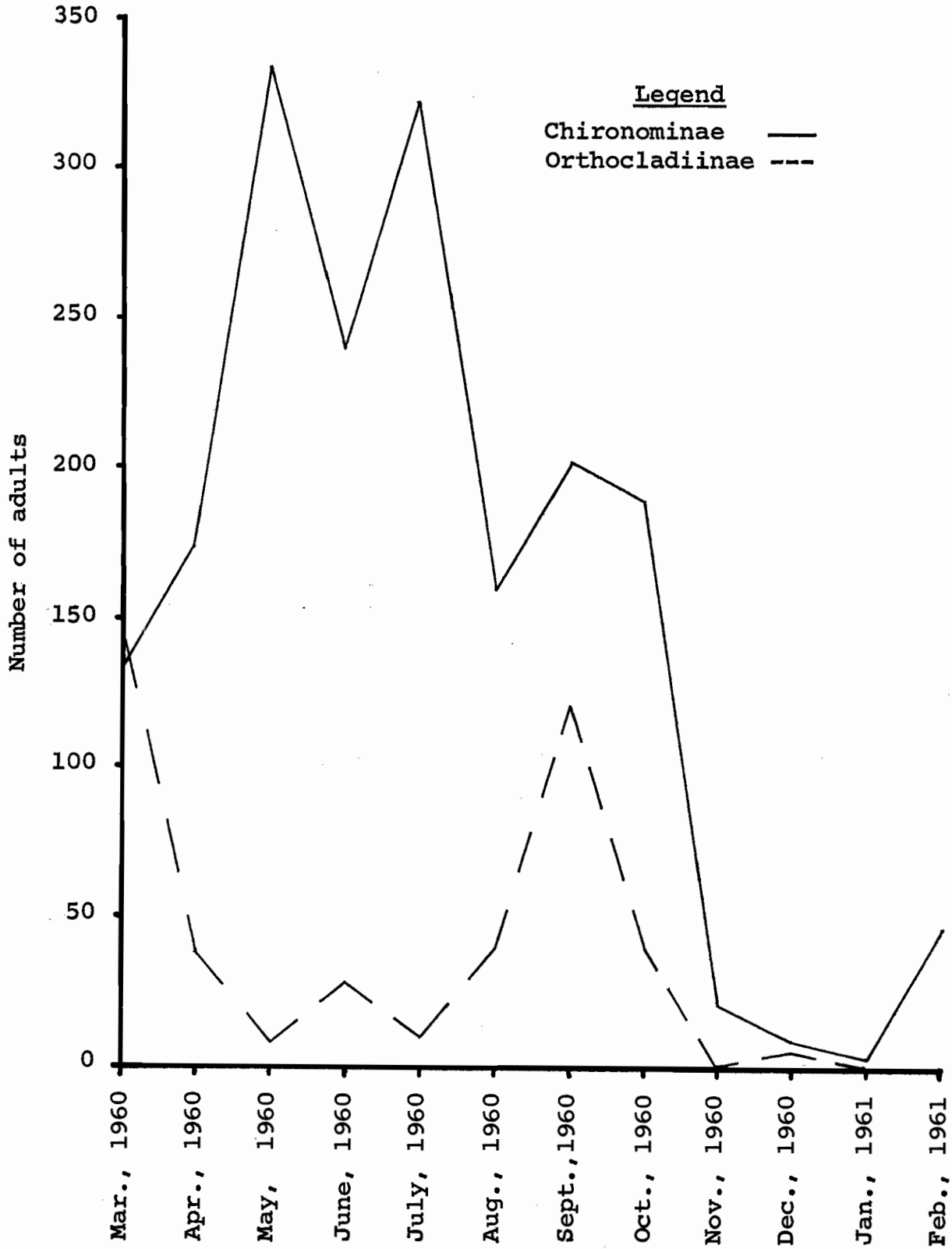
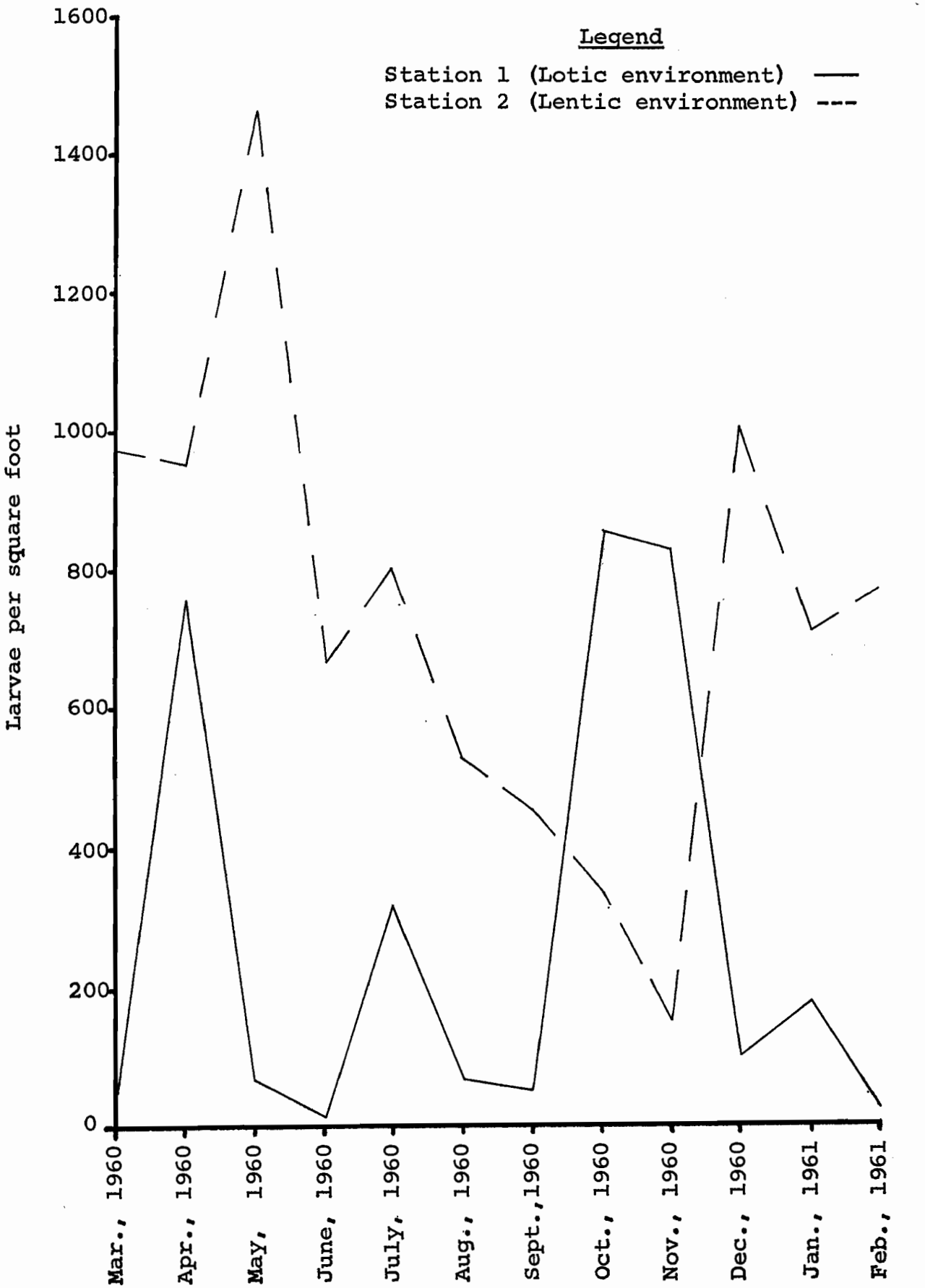


FIGURE 2.
Average number of chironomid larvae at two sampling stations based on two sampling periods per month, 1960-61.



tions, may have shown even lower oxygen values than occasionally experienced. Lake Dalwigk has heavy algal blooms and supports both mosquito fish *(Gambusia affinis)* and threespine stickleback *(Gasterosteus aculeatus microcephalus)*. Notonectids (Hemiptera) and *Ephydra* (Diptera) are common.

Adults tend to remain near their source. No light trap records are available.

Seasonal Patterns

The Chironominae adults are normally common from February through October, while Orthocladiinae adults are generally abundant in March and September (Fig. 1).

Tendipes species were the major representatives in the light trap collections. Certain chironomids, such as some *Limnophyes* and *Cricotopus* species, are prominent during the cooler months and rarely disperse far from their source.

As stated, midge diversity and prevalence is dependent upon the environment. Variation from year to year (Table 1) is not uncommon and may in part be attributed to climatological conditions influencing the development of the aquatic biota. Creeks may be scoured at times, thereby altering the substrate and temporarily deferring midge development. The relative abundance of midge larvae vary seasonally and from year to year in accordance with the availability of food and tube construction material.

Although some species are ubiquitous, specific habitats are usually responsible for the presence or absence of a species. Occasionally, a species (e.g., *T. californicus)* may initially occupy the bottom ooze, moving to a more favorable habitat of aquatic plant growth as the season progresses (Darby 1962).

In many lotic and lentic environments *Tendipes* species apparently overwinter in the larval stage (Fig. 2).

Discussion of Habitats and Larval Populations

Each habitat exhibited seasonal environmental changes during the year, such as flooding, fluctuating water levels and stream flow, prevailing temperatures, emergent vegetation and algal growth, silting, etc. These factors greatly modified the physical, chemical and nutritive conditions within the larval habitat. An understanding of some of these basic factors may considerably aid in anticipating the need for and selection of control measures; hence, certain observations and an analysis of physical changes affecting the principal species composition within these sources are given below.

Aquatic Station 3, representing a sluggishly-moving creek, is at times grossly affected by quantities of moving water which wash out planktonic and poorly-anchored forms; more importantly, silt is introduced or redistributed over existing organic matter as well as the organic debris brought by the floodwaters. Species inhabiting the deeper substrate at this station were usually destroyed or washed away by such water flow; however, the more substantial emergent vegetation with its clinging algae helped to preserve midge populations normally encountered in such a microhabitat. After such silting and redeposition of organic debris, reinfestation by substrate inhabiting forms often quickly followed. Thus, sampling showed moderate populations of *T. attenuatus* from the deeper substrate shortly after the heavy early spring rains. Larval development was rapid and adult emergence was prevalent in April, May and June for this species. In other creek bottoms winter floodwaters did not tend to scour creek beds and bottom species persisted in situ, even though covered with an inch or two of silt.

Aquatic Station 3 also provided an environment for other species which utilized the considerable vegetation (Plate 1) and the attached algal growths as their microhabitat. *Cricotopus* spp. and *T. californicus* were here represented and winter larval populations were able to survive the floodwater currents where suitable substrate conditions prevailed. *Cricotopus* sp. 12 was in fact at the peak of emergence during such rainy periods (February to April). Although present in winter, *T. californicus* and *C.* n. sp. 13 were most prevalent in summer, apparently in association with extensive algal growth.

Aquatic Station 1, representing a slow-flowing water environment with no true riffle areas, is only moderately affected by winter flooding. The larval population is not greatly disturbed by the increased water flow and very little silt is deposited during the rainy period. The rich organic matter, including decaying vegetation, favors the development of *T. stigmaterus* which was observed to pupate from limited marginal areas of saturated muck. An increase in the number of *T. atrella* and *T. stigmaterus* larvae seems to be correlated with the renewed growth of emergent and submerged aquatic vegetation which is utilized as additional substrate.

Cricotopus spp., rarely numerous, are dependent on submerged aquatic vegetation and attached algae which are most abundant in summer (Plate 1).

The fauna is not diverse at this site owing to the limited microhabitats and the sustained organic enrichment. It is not uncommon for the snails *(Physa)* to constitute about 40% of the bottom fauna during the spring and summer.

Artificial drainageways such as this are nearly always highly productive sources of midges, due primarily to their low gradients and consequent lack of scouring and their highly organic bottoms.

Aquatic Station 2, a nearly permanent aquatic habitat, is typical of many marshland chironomid sources (Plate 1).

The presence of chironomids is largely dependent on the time of year at this pond since the abundance of water directly affects the welfare of all species. At this stage in its evolution, such a shallow site with a fluctuating water source has led to a variety of microhabitats which are subject to slow but constant change. As a result, may species with varied habits and emergence cycles were characteristic of this site.

The adults of certain species, such as *Limnophyes* sp. 2, *Pseudosmittia* n. sp. 2 and *Micropsectra nigripilus*, were most abundant during the cool fall, winter, and early spring months. The warmer spring weather accompanied by occasional rainfall stimulated the development of the *Tendipes* larvae, especially those of

T. attenuatus and *T. atrella*. *T. tuxis* adults seemed to be most prevalent when the water source was somewhat depleted (Table 1).

T. atrella larvae were primarily associated with surface ooze and decaying plants. The larvae of both *T. attenuatus* and *T. atrella* frequent decaying decumbent cattail stems, whereas the larvae of *T. tuxis* are associated with the surface of the bottom ooze. *T. tuxis* may to some extent be associated with green algae common to the substrate. It is possible that when this source begins to diminish the remaining water habitat is most faborable to the development of *T. tuxis* larvae, rather than to those *Tendipes* species associated with the decomposing cattail stems and creeping rootstocks that are somewhat elevated and subject to drying.

The predominant chironomid in Station 4 (Plate 1) is *Tanytarsus* n. sp. 57, which possibly survives the low oxygen conditions in this brackish water pond by virtue of its haemoglobin. *Tendipes* larvae were taken occasionally in bottom samples. Dense adult *Tanytarsus* populations were observed in March, May, June and July, and then again in August and September.

This little-known chironomid is relatively widespread in ponds and other lentic environments on the marshlands and has attracted considerable attention due to the heavy adult densities. Fortunately, the adults do not migrate more than a quarter of a mile from their source.

The larvae construct tubes of mud and organic debris on the surface of the ooze or at the base of submerged aquatic vegetation. Like other members of the genus, they are algal feeders and it is possible that the algal blooms observed in nearly all of its known sources provide for and sustain the dense larval populations (over 1000 fourth instar larvae per square foot) seen prior to heavy adult emergence.

This species is highly tolerant of brackish water and thrive where organic pollution is minimal. At Station 4, prior to the establishment of *Gambusia affinis*, *Culex pipiens* was occasionally abundant. The biota of this pond is composed of a limited number of species, but the abundance of these is indicative of an earlier state of high pollution; however, it is doubtful that this *Tanytarsus* species can succeed where gross pollution exists. The fact that a member of *Tanytarsus* has become so well adapted to these eutrophic ponds is unexpectd since nearly all members of this genus prefer well-aerated water.

Habitats Summary.—The foregoing observations have been presented as possible criteria in selecting control measures for such varied sources, rather than to attempt a comprehensive appraisal of species biology or habitat ecology. Certain basic observations governing midge potentials were strongly supported, some of which might aid in evaluating the needs in a diverse program of midge control in similar areas.

Variations in the aquatic habitat such as water fluctuation, depth, substrate variation and vegetation potentials, encourage species diversity, and have a bearing on the number of minor emergence peaks for all species inhabiting the source.

All of the observed species were attached to the bottom substrate or vegetation at various levels (although some species were on floating algal growths); hence, control is more efficiently directed at substrate habitats than at the total aquatic medium.

Most untreated midge sources exhibit larval development of some species throughout the year.

Most sources of high chironomid production represent an evolutionary stage in the shift from low to higher or high to lower organic content. Although not as frequent a problem, sources demonstrating active decomposition due to marked organic pollution frequently contribute heavy chironomid production.

Uniformity of source environment and high organic content usually provide for high density of a limited number of species with repetitive population peaks; those of lower organic content usually provide for extended emergence periods at seasonal intervals.

Stable environments, where the introduction of raw organic matter does not overbalance the established agents of decomposition, do not tend to support high midge populations.

Even low to moderate human population densities within a drainage basin will upset the balance between such organic wastes and the established decomposition agents.

Any of several factors involved in the natural decomposition of organic matter are readily altered by man's normal influence on the environment, modifying the rates of interacting factors within the decomposition stages and environmental balance. Such man-induced alterations may lead to secondary changes as a direct result of the imbalance, e.g., increased nitrogen content and subsequent vegetative growth. If this imbalance increases, with higher accumulative rates of organic matter being introduced, many of the more slowly established agents of decomposition, such as snails, fish and other insects, may be destroyed. This may increase the imbalance further, even to the point of preventing midge production. When this stage of pollution is reached, man usually finds it essential to provide improved drainage flow and waste removal, whereon such sources go through a descending evolution back towards an improved balance of decomposition factors—on occasion.

Thus we find the principal areas of midge prevalence shortly behind the advancing perimeter of suburban growth; principal sources are the low gradient waterways or sites of eventual deposition of increased organic matter from such water sources. These midge problems tend to persist until the land development becomes stabilized, the assessed valuation permits costly drainage installations, dredging and pumping, or until the fluctuations at the perimeters are inadequate to overbalance greatly the decomposition potentials of the rest of the drainage system. Locally, this period appears to range from 10 to 30 years; hence, more efficient methods of meeting the problems of midge control are continually being sought.

Observations on Midge Control

Although control methods for extensive sources such as lakes and major drainageways merit separate study, consideration here is limited to the diverse smaller sources described above.

It is usually considered impractical or economically infeasible to attempt control through counteracting the already present organic matter or resultant vegetative growth. Where it is possible to reduce or eliminate major contributions of such pollutants, this is highly desirable; however, most control approaches will necessarily be restricted to the local source alone.

Chemical Control.—Reports of the success of emulsifiable Baytex® against mosquito larvae (Mulla *et al.* 1961) and chironomid midges suggested further field testing of this material. However, the larval habitat of many of these midges is in the top few inches of the organically rich ooze which often forms the bottoms of permanent and semipermanent water impoundments or slow-moving streams. Most liquid formulations are rendered ineffective due to their inability to penetrate sufficiently into the larval zone in adequate concentration unless applied at rather high rates, although bottom-breaking emulsions have been effectively employed by the San Joaquin Mosquito Abatement District. With the introduction of Baytex in a special granular form (Durham Chemical Co.) it was decided to test its effectiveness on midges under field conditions, inasmuch as other granular materials have been used successfully.

Two test sites were selected with bottoms composed of ooze and decaying organic matter with some emergent vegetation. Plot I, measuring 50 feet by 150 feet, is completely isolated from the surrounding area by a four-foot levee. Water depth at the time of the test was 4 to 12 inches. Due to its isolation it contains water only during the winter and spring, the depth dependent upon rainfall. Plots II and III, measuring 15 by 50 feet, were established in a slow-flowing drainage ditch with water supplied throughout the year by golf course irrigation runoff. These plots include flowing water in the central portions with eddies and saturated ooze toward the margins. A buffer zone of 20 feet was left between the plots to prevent contamination by overlapping of insecticides during application. Normal seasonal populations (Fig. 2) of midge larvae *(T. stigmaterus)* were distributed throughout both sites. Two to three mosquito larvae and pupae *(Culex tarsalis)* per standard one pint dipper were present in Plot I; none were found in Plots II and III due to a large population of *Gambusia.*

Since Baytex is an organophosphorus compound, it was decided to use a chlorinated hydrocarbon of similar insect toxicity for purposes of comparison. When laboratory tested on a susceptible strain of *Culex pipiens quinquefasciatus* (Mulla *et al.* 1961), dieldrin was found to have an LD_{90} of 0.015 p.p.m.

On April 6, 1962, 1% Baytex granules, designated as Duratex H.R. Granules I, (Durham Chemical Co.) were applied to Plot I at the rate of 0.1 pounds (active) per acre. Application was made with a Type 75 Kiekens Whirlwind Holland shoulder-moutned power blower. The granules dispersed with this equipment were uniformly distributed over the bottom of the test area. On December 5, 1962, 1% Baytex granules were applied to Plot II (the downstream plot) at the rate of 0.2 pounds (active) per acre. Six days later 5% dieldrin granules, designated as Dielgran 5, (Chipman Chemical Co.) were applied to Plot III (upstream) at the rate of 0.5 pounds (active) per acre. The small size of Plots II and III and the consequently small amount of material used necessitated hand application. Visual observation indicated a relatively uniform distribution of granules in these plots.

In all plots pre-treatment larval sampling was done immediately prior to insecticide application, with post-treatment sampling at 24 and 120 hours in Plot I, and at 24 and 48 hours in Plots II and III. Sampling in Plot I was random, while sampling in Plots II and III was deliberately biased to include the saturated ooze, eddy, and flowing portions of these plots. Sampling results are tabulated in Tables 4 and 5.

TABLE 4. Effects of granular formulations of Baytex and dieldrin on immature chironomid midges.

Plot	lbs/acre (active)	Pre-treatment larvae/sq.ft.	Post-treatment larvae/sq.ft. 24 hrs.	48 hrs.	120 hrs.	% reduction (final)
I (Baytex)	0.1	625	92	-----	153	76
II (Baytex)	0.2	892	60	217	-----	76
III (dieldrin)	0.5	508	38	110	-----	78

TABLE 5. Distribution of larval populations in Plots II and III (totals combined).

	Saturated ooze (margin)	Larvae/sq.ft. Eddies	Flowing Water (central)
Pre-treatment	832	281	287
Post-treatment (48 hrs.)	8	167	152

The results of these tests indicate that both Baytex and dieldrin granules are effective against chironomid midges under field conditions, although the degree of reduction was somewhat less than anticipated. The possibility of chemical or physical inactivation of the toxicant by the organic substrate, resulting in lower effectiveness of the toxicant, is always present; how-

ever, the mortality (76% or greater) obtained indicates that this was not of prime importance, although it may have been a contributing factor. Perhaps a more important factor is the distance between the individual granules. This distance may be too great for sufficient diffusion of the toxicant, in lethal amounts, through the substrate to reach all of the larvae. The selection of a material with a lower concentration of toxicant, but a larger number of granules per unit area, for application at the above rates (thereby reducing the distance between granules) may provide the desired diffusion.

The lack of significant increase in mortality between the two Baytex plots (76% in Plots I and II), despite an increase in the application rate in Plot II, may be attributed to the type of granule used. The Durham H.R. granule consists of a sand grain core with a toxicant contained in a light, porous carrier held by a highly water soluble binding medium. When emersed, the carrier is released almost immediately and rises to the surface where it remains until it becomes saturated and sinks to the bottom. During this time the toxicant is released and is well distributed throughout the water. In impounded water this action is not objectionable because irrigated midge larvae and pupae which leave the ooze contact the insecticide in the water. In flowing waterways, however, the floating material is quickly washed away and a large percentage of the toxicant is lost. No doubt some dieldrin was also washed away in Plot III and might account, in part, for the somewhat low mortality; mortality was higher at the plot margins than in the central area with some stream flow.

In Plots II and III the concentration of the larval population prior to treatment was greatest near the margins, decreasing toward the center. After treatment the situation had reversed, the greater population concentration being nearer the center of the plots (Table 5).

This reversal of the larval distribution pattern is probably due to a washing away of the toxicants in areas of greater water movement, resulting in a reduced mortality in those areas. Although toxicant irritated larvae leave the substrate and swim about freely, the probability of significant numbers moving toward the central areas of the plots is remote; no such oriented migration was observed.

A considerably larger number of larvae were found in the final than in the 24 hour post-treatment sample (Table 4). The reduced number of larvae in the 24 hour ooze samples may have resulted from the tendency of irritated larvae to leave the substrate. At the time of the final sampling, larvae receiving a sublethal dose of insecticide had returned to the ooze, accounting for the apparent increase in numbers. Reinfestation is doubtful because of the number of third and fourth instar larvae present and the insufficient time between the 24 hour and the final sampling for this degree of development.

A large population of *Gambusia* in both Plots II and III were little affected by either insecticide. A high tolerance of mosquito fish to Baytex has been reported by Mulla and Isaak (1961) and no ill effects were anticipated. It was noted, however, that Baytex was responsible for the death of many Odonata nymphs in Plot II. Dieldrin has been reported (Communicable Disease Center 1956) as having a high toxicity to fish and some mortality was expected. Surprisingly, only one mosquito fish was found dead in Plot III, and it was isolated in a small pool containing dieldrin granules.

These tests indicate that dieldrin may be used with comparative safety to *Gambusia* in flowing water sources when applied at low rates, but that Baytex is probably a better choice in impounded water when fish are present. In addition, Baytex has a low dermal toxicity to mammals compared to dieldrin. Gaines (1960) reported an acute dermal toxicity to rats of 330 mg/kg for Baytex and 60-90 mg/kg for dieldrin; hence, the former is recommended in areas where danger of contamination of children or animals exists.

Control Through Environmental Manipulation.— Ecological conditions influencing the development of chironomids are numerous. This is true primarily because the larvae of the Chironomidae are a diverse group of organisms occupying many habitats and acting as predators, scavengers, and herbivores. It is axiomatic that knowledge of the biology and ecology of the pest species is necessary before control employing environmental manipulation can be instituted.

A changing environment may be deleterious to the establishment of a midge species. Jamnback and Collins (1955) reported the correlation between increased salinity and the reduction of *T. attenuatus* (=*decorus*) larvae in Moriches Bay. Seal Slough in San Mateo, California, which receives flood waters and also serves as a recreational area in summer, has on occasion produced a large *Tanytarsus* population. If the slough is flushed periodically with salt water the ecological conditions favorable to larval development are lacking or greatly reduced.

Creeks under frequent tidal influence from San Francisco Bay generally lack midge larvae. Laurel Creek, at Station 3, has reflected the results of some salinity by specific gravity readings as high as 1.008 beginning just prior to February 16, 1960. The results of this tidal influence are shown in Table 6. The specific gravity may have been higher at times, but the values reported in Table 6 are those obtained when the bottom samples were taken.

TABLE 6. Effect of salinity on chironomid larvae during 1960.

Date		Highest sp. gr. value recorded	Number of larvae per sq. ft.
January	19	1.000	177
February	2	1.001	41
	16	1.006	3
March	3	1.004	
	14	1.008	
	28	1.000	
April	11	1.000	35
	26	1.000	26
May	9	1.000	125

Midge production is often recurrent in ephemeral bodies of water. Many of these sources are the result of poor drainage practices which can frequently be rectified.

Dredging drainageways only temporarily reduces larval development but may be an effective control measure for an entire season if properly timed. The cost of this control practice is not often justified, especially if no modifications are instituted to reduce future organic deposition.

Many drainage channels that become choked with emergent vegetation are best managed by first dredging and then periodically applying a herbicide. Algicides may serve as an effective control for certain nuisance species, but their use must be restricted where fish are established. Many serious infestations develop from artificial drainageways which frequently support considerable vegetative growth.

Environmental modifications which tend to establish increased biotic diversity in creeks and lakes are to be recommended, whereas wastes which rapidly accelerate eutrophication in drainageways and lakes are to be discouraged.

Summary

The members of the subfamily Chironominae are considered to be the most pestiferous due principally to their prevalence and widespread occurrence. *Cricotopus* n. sp. 13 and *Smittia* sp. (near *aterrima)* are the only two Orthocladiinae considered pestiferous within the area surveyed.

The seasonal pattern is largely determined by the development of the ecological conditions in the larval habitat. Therefore, the number of generations and population density for a species appears to be primarily a product of the environment. Moderate or excessive pollution was frequently correlated with reduced biological diversity and heavy adult midge infestations.

Chemical control by granular Baytex 0.1 and 0.2 lb. per acre provided fairly effective reduction of *Tendipes* larvae in impounded and slowly-moving waters, with no harm to mosquito fish, *Gambusia affinis.* Granular dieldrin showed promising control in slowly-moving waters, with little harm to *Gambusia* and aquatic invertebrates at 0.5 lb. per acre.

Artificial drainageways tend to produce greater midge infestations than do natural drainage creeks.

Some modifications of the environment to limit midge production are possible. Integrated control is generally the most desirable approach if management on a continuing basis is desired.

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SOME PHYSICO-CHEMICAL FACTORS INFLUENCING THE PERFORMANCE OF NEW GRANULAR MOSQUITO LARVICIDES

Mir S. Mulla

Department of Entomology, University of California, Riverside

Granular formulations of insecticides are complex systems and their effectiveness in insect control is determined by a variety of factors and conditions. The physical and chemical properties of the ingredients making up the formulation influence the effectiveness of the formulation. In addition, biological and edaphic conditions under which the materials are to be used, also influence the final performance of the formulation.

Some of the advantages of granular insecticides over sprays as employed for the control of insects of public health importance breeding in soil or water are enumerated below.

1. *Penetration of Plant Cover.*—Granular particles applied by aircraft for mosquito larval control for example, penetrate the plant canopy and deliver the toxic dose to the water supporting larval population. Based on the actual toxicant applied, over 90% of the dosage reaches the breeding source. By contrast, spray droplets are intercepted by plant cover and usually less than 20% of the dosage, depending on the type of cover, reaches the water underneath (Mulla *et al.* 1963).

2. *No Residues on Crops.*—Since granular particles pass through the plant canopy and do not cling to plant foliage, they leave very little or no toxic residues in or on forage or food crops. Initial residues in alfalfa hay were determined for parathion and Baytex® applied at the rate of 0.1 lb./acre both as granules and sprays. The granular formulations resulted in no significant initial residues while the sprays resulted in residues above the tolerance level (Mulla *et al.* 1963). Based on the penetration qualities of granules and sprays, this trend of residues is to be expected. Granu-

lar formulations may result in some low level residues on plants covered with dew. This problem, however, may be overcome by making the applications at a time when dew on plants is at a minimum.

3. *No Drift.*—In a 15/30 mesh size granular formulation, most of the particles have a diameter of 1.0 to 2.5 mm. These particles do not reduce in size after being discharged from the aircraft. By contrast spray droplets reduce in size after discharge due to evaporation of the liquid or breakdown of larger particles into smaller ones. It is the smaller particles which remain suspended in the air and are thus swept away from the site of application, resulting in drift over agricultural, recreational and residential establishments. Granular particles, being much heavier than spray droplets, do not remain suspended in the air.

In a study of the residues and deposits of granular and spray parathion and Baytex, approximately 40% of the spray was not accounted for at the site of application (Mulla *et al.* 1963). It is assumed that this dosage was deposited somewhere else. On the other hand, almost the total dosage administered in granular form was accounted for at the site of application (Mulla *et al.* 1963).

4. *Safety to Bees and Other Beneficial Insects.*—By the very nature of residues incurred on plants by the application of sprays, loss of bees and natural enemies of plant pests is to be expected. This loss is greatly minimized when granular insecticides are substituted for sprays in treating mosquito breeding sources located in agricultural fields (Anderson and Atkins 1962). Loss of bees and beneficial insects due to contact and vapor in spray treated areas is also considerable. Such loss in granular treated fields was found to be insignificant.

5. *Safety to Applicators.*—Most of the hazards arising from the use of toxic materials occur during storage, mixing or application of these toxic agents. Liquid forms are accidentally swallowed, spilled or inhaled, thus posing a potential hazard to applicators and others, granular materials are dry and in a dilute form. Their concentration ranges from 1 to 10%, while liquid concentrates range from 25 to 80%. Due to the oil content, the liquid formulations are readily absorbed through the skin.

Liquid concentrates have to be diluted for application and this procedure at times may create conditions conducive to accidental poisoning. Granular materials on the other hand are in the final form and can be easily transferred from containers to aircraft hoppers.

6. *Speed and Economy of Application.*—Since granular formulations require no mixing and diluting, they are more rapidly applied than sprays. No sprayers, nozzles, hoses, pumps or other cumbersome equipment are necessary for dispersal of granular formulations. A consideration of the overall application cost by some mosquito abatement agencies in California, places granular materials on an equal basis with sprays. Cost per unit toxicant formulated as granules is higher than the liquid formulations, but the difference in cost of application makes up for the difference in cost of the toxicant. Further analysis of the comparison of cost of treatment with sprays or granules is necessary.

7. *Regulated Rate of Release.*—The rate of release of a toxicant from a granular particle can be readily controlled. This technique has some excellent possibilities in long-lasting control of mosquito larvae in pre-hatch as well as post-hatch treatments. This promising approach is currently under study.

Although granular materials offer numerous advantages over sprays for mosquito larval control, they nevertheless have some specific disadvantages. The initial high cost per unit toxicant discourages one from using granules. However, as stated previously this cost difference can be absorbed by speed of application and by avoiding tear and wear of equipment in spray application. Since granules leave little or no residues on vegetation and surfaces, they naturally do not act as adulticidal agents.

The most obvious disadvantage or weakness of granular mosquito larvicides is the slow release or availability of toxicants from the granular particles. For mosquito larval control, generally rapid release of toxicants is essential. In order to obtain this end result it is imperative that one know the underlying factors influencing the performance of such formulations. Although biological, environmental and physico-chemical factors are involved, our studies have been primarily concerned with the latter.

Methods and Materials

Basically, granular formulations are prepared by impregnating carrier particles with a toxicant solution or coating toxicant powder onto an inert core. Other additives may be incorporated for various reasons. Each ingredient that goes into the formulation undoubtedly influences the ultimate performance. The various formulations were prepared in the laboratory in the same manner as described elsewhere (Mulla and Axelrod 1960, 1962). The tests were also conducted in the previously established manner using mosquito larvae as bioassay organisms.

Carriers

Inert carriers play an important role in the performance of granular insecticides. A carrier suitable for one toxicant may not be a suitable one for another. Stability and compatibility factors have to be considered for each material. Other physical characteristics such as bulk density, flowability, shape of particles and hardness deserve consideration.

A good number of the non-metallic mineral carriers such as attapulgite, montmorillonite, Frianite, sericite, vermiculite and diatomite were found satisfactory (Mulla and Axelrod 1962). Calcium carbonate, talc and pyrophyllite did not prove promising in parathion formulations. Corncob grit also proved effective. The carriers also determine the pattern of distribution and coverage of granular materials applied by aircraft. An important consideration in the selection and application of a granular carrier is the particle size. An inverse relationship exists between the magnitude of release of parathion and the particle size of attapulgite, montmorillonite, calcite, sericite, Frianite and corncob granules. Finer particle materials, although more efficient, are not suitable for aircraft application for mosquito control in or adjacent to agricultural and residential areas. Penetration of plant cover by these

particles is poor. Carriers of this type create drift and toxic residue problems in these areas. The 15/30 mesh materials are the most desirable for mosquito control in California. Carriers with particles in this range have good physical characteristics for penetrating plant canopy and yielding good coverage and particle distribution. Particles larger than 15/30 are likely to yield too slow a release, poor coverage of the treated breeding sources and spotty distribution. The relationship between particle size, toxicant concentration, rate of application and equipment on the one hand and adequate and proper coverage on the other should be considered prior to the selection of a granular carrier.

TABLE 1.—Release of experimental organophosphates into water from granular corncob formulations.[a]

	Avg. % release after indicated intervals (hrs.)			
Toxicant	8	24	48	72
Methyl parathion	100	100	98	100
Sumithion	100	100	100	100
SD-7438	.....	27	47	61
SD-7587	100	100	100	100
SD-7554	100	100	100	100
G-30494	56	67	86	80

[a] Toxicant concentration 1%, carrier: corncob grit 30/60. Solvent: acetone. Release determined at 85° F. Larvae exposed at 75-80° F. Added at 1 p.p.m. to one gallon of water in a glass jar.

TABLE 2.—Release of Sumithion from granules into water using different carriers.[a]

	Percent release at indicated intervals (hrs.)		
Carrier	24	48	72
A-LVM	75	86	84
A-RVM	85	81	77
Celite	94	83	80
Vol Clay KWK	67	81	68
Corncob	75	85	90
Pikes Peak Clay	76	84	78

[a] The formulations contained 1% Sumithion. Acetone at 10% used as solvent. Granules added at 2 p.p.m. toxicant to one gallon of water in a glass jar. Release determined at 85° F. Larvae exposed at 75-80° F. Carriers 30/60 mesh in size.

TABLE 3.—The role of surfactants in the performance of 1% granular formulations of Baytex as evaluated against larvae of *Culex pipiens quinquefasciatus*.[a]

			Percent release after hours		
Surfactant[b]	*Chemical description*	*Water no.*	24	48	72
Sponto 60	Polyoxyethylene sorbital—Tall oil ester	12.6	30	54	56
Sponto 217	Alkyl aryl polyether alcohols and special sulfonates	17.8	18	29	33
NX-80	Nonylphenoxy poly (ethyleneoxy) ethanol	22.5	28	29	37
NX-100	Nonylphenoxy poly (ethyleneoxy) ethanol	23.0	32	57	62
NX-150	Nonylphenoxy poly (ethyleneoxy) ethanol	24.0	67	87	89
NX-2	Polyoxyethylene phenolic resin	17.6	17	22	35
NS-29	Ethoxylated aliphatic alcohol	22.8	28	48	67
NS-30	Ethoxylated aliphatic alcohol	23.2	29	64	75
FX-100	Dinonyl phenoxy poly (ethyleneoxy) ethanol	16.5	0	0	27
RAD-1100	Ethylene oxide condensation product of amines	18.5	0	20	27
RAD-1110	Ethylene oxide condensation product of amines	18.2	27	96	17
Tallex-120	Polyoxyethylene ether	11.6	55	60	77
Tallex-150	Polyoxyethylene ether	13.1	0	17	32
FR-77	Amine salt of sulfonic acid	20.1	26	43	65
FR-79	Amine salt of sulfonic acid	21.5	30	100	78
FR-62	Sodium salt of sulfonic acid	20.5	6	58	83
FR-47	Alkyl benzyl quarternaries	19.4	0	17	47
RCC-50	Alky aryl poyloxyethylene glycols and fatty acids	20.3	26	65	75
D-40	Polyalkylene glycol ether	18.8	0	47	67
CX-40	Polyoxyethylene lauryl ether	18.5	17	18	30
Control	No surfactant	.....	40	80	88

[a] The formulations were prepared by impregnating acetone solutions of the toxicant and surfactant onto 30/60 attapulgite granules. The surfactant comprised 5% of the finished formulation.

[b] Retzloff Chemical Company, Houston, Texas.

The release of 6 new mosquito larvicides into water from 30/60 corncob grit granules was studied. Methyl parathion, Sumithion®, SD-7587, and SD-7554 released rapidly, while SD-7438 and G-30494 were released slowly (Table 1). This slow release is possibly a characteristic of the compound and possibly a result of the carrier.

The over-all pattern of release of Sumithion from 6 types of carriers was essentially the same (Table 2).

Surfactants

The role of a large number of surfactants has been investigated in the performance of granular formulations of Baytex and other mosquito larvicides. The result has invariably been that of depressing the magnitude and rate of release into water (Mulla 1962) and (Table 3).

From Table 3 it is evident that there is an overall relationship between the water number of a surfactant and its role in the efficiency of the formulation. In most cases, as the water number in a series of surfactants increased, there was a corresponding increase in the release of Baytex from the formulation containing the surfactant.

The incorporation of other surfactants into the granular formulations of Baytex using 30/60 A-LVM attapulgite granules did not in any overall speedier release than in the control (Table 4). Those materials having higher water solubility or dispersibility (higher water number), yielded better release than those materials having lower water number.

Six newer mosquito larvicides were formulated on 30/60 corncob granules using acetone as solvent for impregnation. Three surfactants were also incorporated in the formulations of each material. It is evident that material NS-176 resulted in lower release of each toxicant than Sponto 60 and NS-2 (Table 5). Although NS-176 and NS-2 belong to the same category of compounds, the former compound depressed the release of all six materials. It is important to note that the water number of NS-176 is higher than that of NS-2. As seen with the other groups of surfactants, compounds with higher water number should have resulted in rapid release, but apparently this physical characteristic does not act independent of other factors.

The relationship of dosage of active ingredient applied to water as granules was studied. Five surface active agents were added to 1.0% Baytex formulations on 30/60 A-LVM attapulgite granules. The granules were applied at rates to give 0.5, 1.0 and 2.0 p.p.m. active toxicant dosages in the treated water.

Table 4.—Release of Baytex from granules into water using different surfactants.[a]

Surfactant[b]	*Chemical description*	*Water no.*	*Per cent release at indicated intervals (hrs.)* 24	48	72
FX-220	Dinonyl phenoxy poly (ethyleneoxy) ethanol	23.5	67	90	96
D-50	Polyalkylene glycol ether	20.6	70	93	100
Tallex-80	Polyoxyethylene ether	10.0	66	76	68
FR-56	Alkyl benzyl quarternaries	13.4	72	65	56
NS-139	Polyoxyethylene thioether	19.4	64	83	83
-------		-------	72	100	100

[a] 1% Baytex on 30/60 A-LVM attapulgite granules. Acetone at 10% used as solvent. Surfactants added at a concentration of 5% during impregnation. Granules added at 2 p.p.m. toxicant in a gallon of water in a glass jar. Release determined at 85° F. and the larvae exposed at 75-80° F.

[b] Retzloff Chemical Company, Houston, Texas.

Table 5.—Release of 6 different new mosquito larvicides from granules into water using 3 different surfactants.[a]

Toxicant	*Surfactant*[b]	*Avg. % release at indicated intervals hrs.* 8	24	48	72
Methyl parathion	Sponto 60	-----	100	100	100
	NS-176	37	100	65	63
	NS-2	100	100	100	100
Sumithion	Sponto 60	-----	100	100	100
	NS-176	59	80	74	74
	NS-2	100	100	100	100
SD-7438	Sponto 60	-----	67	50	0
	NS-176	32	28	38	25
G-30494	Sponto 60	-----	87	76	73
	NS-176	0	73	65	59
	NS-2	84	100	65	56
SD-7587	Sponto 60	-----	100	100	100
	NS-176	0	82	64	64
	NS-2	84	100	65	56
SD-7554	Sponto 60	-----	100	100	100
	NS-176	73	87	73	80
	NS-2	94	100	100	100

[a] Toxicants 1%; surfactants 5%; carrier corncob 30/60. Solvent: acetone. Release determined at 85° F. Larvae exposed at 75-80° F. Granules added at 1 p.p.m. toxicant in one gallon water. Surfactant added at 5% concentration during impregnation.

[b] Sponto 60—Polyoxyethylene sorbitol–tall oil ester–water No. 12.6.

NS-176—Polyoxyethylene phenolic resin–water No. 21.7.

NS-2—Polyoxyethylene phenolic resin–water No. 17.6.

TABLE 6.—Release of Baytex from granules into water using various toxicant dosages and different types of surfactants.[a]

Surfactant[b]	*Water no.*	*% release at indicated intervals* 24 hr.	48 hr.	72 hr.
		Dosage 0.5 ppm in jar		
NS-2	17.6	86	99	74
CX-40	18.5	89	84	72
NX-80	22.5	84	73	82
Sponto-60	12.6	85	77	78
NS-176	21.7	71	71	89
----------	------	95	71	81
Avg. % release		85	79	79
		Dosoge 1.0 ppm in jar		
NS-2	17.6	82	93	69
CX-40	18.5	77	62	70
NX-80	22.5	67	61	77
Sponto-60	12.6	78	62	68
NS-176	21.7	71	58	69
----------	------	73	57	59
Avg. % release		75	65	69
		Dosage 2.0 ppm in jar		
NS-2	17.6	61	63	83
CX-40	18.5	61	63	81
NX-80	22.5	63	65	78
Sponto-60	12.6	74	60	71
NS-176	21.7	74	56	64
----------	------	87	65	71
Avg. % release		70	62	75

[a] One percent Baytex on 30/60 A-LVM attapulgite granules. Acetone at 10% used as solvent. Surfactants added at 5%. Release determined at 85° F. Larvae exposed at 75-80° F. The formulations were aged for 4 months.

[b] Chemistry included in Tables 3-5.

The over-all release from formulations of the five surfactants was essentially the same and not markedly different from the controls (Table 6). However, it can be noticed that average release for the 0.5 p.p.m. was higher than the release at the 1.0 and 2.0 p.p.m. The differences between the releases at the three concentrations may not be significant, but an obvious trend is apparent.

It can be concluded that the studies thus far conducted indicate a negative relationship between the use of surface active agent materials and the speed of release of toxicants from the granules. In few cases the release from formulations with and without surface agents appears to be the same. Water affinity, solubility, or dispersibility may be correlated with the magnitude of release for some of the surface active agents but not for others. Water solubility of the toxicant itself, however, has an important bearing on the magnitude of release of toxicants from granular particles into water.

Although surfactants may not be readily used to enhance the magnitude of release of toxicants, it appears that they might have a place in the development and use of formulations having stability and longevity requirements. Further studies along these lines are in progress.

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FIFTH SESSION

WEDNESDAY, JANUARY 30, 8:30 A.M.

J. D. WILLIS, *Presiding*

PANEL: TECHNIQUES ON ACHIEVING PROGRAM OBJECTIVES

W. DONALD MURRAY, *Moderator*

TECHNIQUES ON ACHIEVING PROGRAM OBJECTIVES: THE SPOKEN WORD

GILBERT T. RITCHEY
Toastmasters International, Santa Barbara; Director, Title Insurance and Trust Company, Santa Barbara

Apparently this is like most conferences, the crowd is a little thinned out due to the early hour. When Dr. Murray first invited me to appear on your program he said, "Could you be here and speak at 8:30 in the morning?" I said, "You mean 8:30 in the evening, don't you?" "No," he said, "I mean 8:30 in the morning." Well, you know, I don't get the cobwebs out until at least noon. In any event, this is not a new experience since, in the course of my work, I have been attending conventions for many years. My company sends me to as many as six or seven conventions each year, and you know I have just about concluded that I am going to stop going; they are too rough. I can't take them.

Now, I don't know why your organization would pick Santa Barbara as a meeting place. We don't have any mosquitoes here. We do have a nudist colony over near Montecito, just a mile or so from here. It has been said that one of the mosquitoes from Goleta blew over to Montecito one day and landed right in the middle of that nudist colony—and was she confused! She knew what to do, but she didn't know where to start.

Now, to set the record straight, I am a Toastmaster, and many people think that a Toastmaster is a finished speaker. This is not true. The only reason I am a Toastmaster is that I am in the process of learning. It is in a sense like being a student in school. If I were a polished speaker—a finished speaker—I wouldn't be in Toastmasters. I am mentioning this so you will not misunderstand the word.

Now let's get into the subject we are to discuss today—the spoken word and its importance. From the time of the caveman, who probably uttered a few ungrammatical grunts to make his thoughts known, until today, the spoken word has been man's most important means of communication. It is estimated that more than three-fourths of all of our communications today are accomplished through the spoken word. A script found in an Egyptian tomb contained this maxim: "Make thyself a craftsman in speech, for thereby thou shalt gain the upper hand." Remember that, gentlemen. It is just as good a maxim and applies as well today as it did 3000 years ago.

What makes the spoken word so all-powerful? The lack of understanding resulting from poor communications between persons has caused wars and has lost battles; it has broken beautiful romances, marriages, and friendships. That is why the oral discourse, or person-to-person communication, is often so extremely important. The use and the importance of the spoken word has been known and valued through the ages, much as it is today. We can, for example, go back 2500 years to the era of Pericles of Athens. Pericles was a scholar, a philosopher, a statesman, and above all he was an orator without comparison. He was one of the first great men of history to realize that the spoken word was greater than the sword, and he stopped many battles by outwitting his enemies with words rather than swords. He also stopped internal uprisings by the use of well-chosen, sincere words. When his populace wanted lower taxes and more food, they would gather in front of the capitol building with sticks and stones. Pericles would then make his appearance on the balcony, and after an hour or so the angry crowd would be dispersed without a stone being thrown. He could have called upon force but found he could utilize his power of speech even more effectively.

Some 500 years later a man by the name of Caesar came on the scene in Rome, and he was also known for his eloquence. He was also smart. He had shortcomings but he surrounded himself with strong men, some of whom could speak even better than he. While Caesar was the mastermind, it was Mark Anthony who became known as the great speaker and the great leader. In fact, it was through his eloquence that he sold Cleopatra a bill of goods.

And so, through history, men achieved greatness through the spoken word. I think of Lincoln and Churchill and Franklin Roosevelt. Much of Lincoln's reputation for speaking, outside of his debates with Douglas, is identified through his brief but powerful Gettysburg Address. Had he written a book, we would do well to remember the title. Nor do we associate Churchill's greatness with the books he wrote. It was in his speeches that we find the famous quotations that everyone knows and recognizes. As for our present President, it appears unlikely that he will win any cups in oratory, although he seems to have talked his way into the White House. But he does have a distinctive style of speaking. His speeches have been moreso identified with a unique style of presentation rather than their content. A fellow by the name of Vaughn Meader put an imitation of the President's voice in wax and the records have gone into some four million American homes. Thus, the President may go down in history as a great speaker on the basis of Vaughn

Meader's performance. And did you know that Meader's imitations are making him more money than if he were President? Incidentally, since I understand there are not very many Democrats here I can tell this. You know, there is a movement on foot to change the name of Washington, D.C. They want to call it "Father Joe's Boystown."

Regardless of the work that you are doing, you are called upon every day to sell somebody something. If you are not selling yourself to your boss, you are selling yourself to your fellow workmen. From the looks of this audience, you did a darn good job of selling your wives on not coming to this conference because it's all work and they wouldn't have any fun anyway. So I know there are a lot of good salesmen here. Undoubtedly, you are called upon to stand up before city councils and county boards of supervisors and sell them on mosquito abatement and the importance of supporting your programs. You can't just send them a letter. That may end up in the round file alongside their desk. Often you have to get right up in front of people and sell them on an idea, and this must be done with sincerity, simplicity, and conviction. If you have an important job to do, don't try to do it with a letter; get there and talk face-to-face to the people you are trying to influence.

It is frequently the proper use of the spoken word that results in professional advancement, as well as support for your programs. Many of you are probably effective speakers; some of you are no doubt excellent speakers. For those of you who might be interested in improving your speaking, there is an organization designed for that purpose and it is called Toastmasters International. This organization was founded in 1924 by Ralph Smedley, now Dr. Ralph Smedley. It was designed primarily to help those who wish to help themselves toward thinking better and speaking better on their feet. Manuals for speech training were developed which were so good that very few changes have been made in that program since 1924. Toastmasters was classified by the U.S. Government as a nonprofit educational organization. I don't believe that any of you here live in a town so small that there is not a Toastmaster charter in that town or one very nearby. There are more than 3500 charters throughout the world. Our materials are translated into many foreign languages so that there is not a free country in the world that does not have active Toastmasters clubs. It is a well-planned course of self-instruction. We say "self instruction" because you have to want it yourself. It is designed not as a short course but for a longer period of time than the average college course. There are also several nationally known and quite expensive special courses in public speaking. Some claim that in six weeks or eight weeks they will make a public speaker out of you that would put Bryan to shame, but there is no such thing, gentlemen. There are no short cuts in learning public speaking. That is why I have been associated with Toastmasters for several years, and I expect to be with the organization a while longer.

If you feel you could benefit from this kind of experience you shouldn't have to look very far before you will find among your friends someone who is a member of Toastmasters. If you do, feel free to say, "Bill, you are a member of Toastmasters;why don't you take me to a meeting? I just want to see what goes on there." He will be happy and flattered to take you and introduce you as his guest. You will not be asked to speak. You will have an opportunity to observe, and at the end you may be invited to say a few words. You may decline without any cause for embarrassment. Visitors are usually there just to observe and to determine whether they might benefit from this kind of experience. A club usually has about 30 members. I think the national organization says we can have a limit of 40, but most clubs are limited to 30 so that each person has a greater opportunity to take part in the meetings. With a membership of 30, it is estimated that an average of 22 will attend a meeting.

Now you may be thinking, "What will Toastmasters do for me?" This is a very reasonable question which I should try to answer. Participation in Toastmasters will aid you in mastering the art of effective speaking. I said "aid." You will be helped in the direction of making a poised, self-assured appearance before any audience. This experience should prepare you for chairmanship responsibilities and other types of leadership roles in groups of all kinds. It should increase your qualifications for business and civic recognition, and it will certainly provide an enjoyable fellowship and a forum for stimulating exchange of ideas and thoughts.

You may be wondering, "What is all this going to cost?" Well, I will tell you, gentlemen, it's pennies. The initiation fee in joining Toastmasters, as I recall, is in the vicinity of $7.50; some clubs are as low as $5.00. Dues will probably be about $15.00 a year. If you have one meeting a week, with 52 weeks in a year, it would amount to less than 30¢ a meeting. In any event, cost will not stand in the way of your joining Toastmasters.

If you decide to join, you will find that your course of instruction has been well planned for you. You will receive a basic training manual which includes 12 speeches. It starts with the "Ice Breaker," which amounts to a short autobiography. As a first speech, this is the easiest one for you to make. You should be able to get up and talk for seven minutes about yourself—"I was born in Oshkosh and raised in Azusa"—and on down to the present, with a general account of your activiites and interest. All talks are timed, and you are supposed to do this first one in seven minutes; however, no one is ever cut off in his initial speech and some have gone as long as 20 minutes.

The second speech is "Be in Earnest." The outline tells you how to make that speech, how to compose it, how to organize it, and how to deliver it. This procedure follows, for the most part, through the 12 speeches included in the preliminary manual.

During each speech you are assigned an evaluator—they are called "critics." I prefer to call them "evaluators." Usually the evaluator is an older member in terms of experience, and knows how to provide helpful criticism for the beginner so that the next time you speak you will try to eliminate some of the more obvious mistakes you made the first time. So it goes, through these 12 basic training speeches.

After that, if you are still interested in Toastmasters,

we have a program beyond basic training. This calls for a little bigger book; in fact, one with 20 speeches. It may require a two to three year program to get through this manual. Of course, when you get beyond basic training your criticism is more severe and sometimes they really lay it on when you get into the second book. But if you just go through the preliminary book, and although you may already be classified as an excellent speaker, I am sure you will learn something from Toastmasters. It is also the experience you receive from listening to the other members, the new ideas exchanged at each meeting and, as I say, at each meeting you have an opportunity to participate actively. You may be an evaluator, or toastmaster of the evening, or you may just be the "ah" counter. Yes, we have an "ah" counter at each meeting. That's the fellow who keeps the record of how many times the speaker says "ah." I happen to be the champion in my club. I'm doing better. I used to score 30 "ahs" in a seven-minute speech and now I have it down to around 20. I hope in the next five years I may be able to eliminate all "ahs."

We also have a timer, and timing is very important. The average meeting lasts two hours—not two hours and a half or an hour and three-quarters. We start on time, end on time, and each part of the meeting is timed and—I do have a time-limit here too, and as I see it's drawing to a close. To be a good Toastmaster I should close on time, and in doing so I am reminded of the elderly preacher who, each Sunday morning, made this little silent prayer to himself before he started his sermon: "Oh, Lord, fill my mouth with worthwhile stuff and nudge me when I've said enough." I just felt the nudge.

TECHNIQUES ON ACHIEVING PROGRAM OBJECTIVES: THE WRITTEN WORD

JAMES GREGG
Director of Student Publications
University of California, Santa Barbara

In keeping with the theme of your conference I propose to talk a bit about some specifics of writing, particularly about the kinds of news releases which mosquito abatement districts might be preparing. Most of you, I think, are associated with rather small organizations as far as governmental agencies go, and obviously you don't have a high-priced public information director in each office; but you probably do have a sharp, and I hope good looking, secretary who might be able to serve this purpose provided you can give her the necessary basic information.

The preparation of releases for newspapers need not be a difficult undertaking. It doesn't require great skill, and you don't have to wear a trench coat; in fact, of the wide knowledge that might be required of a good newspaper man, all you need to know are a few basic procedures. It is a very simple process.

There are a number of factors I should like to mention which determine the acceptability of material that you might send out. A moment ago a member of the panel spoke of reports that you might prepare for your board of trustees. Perhaps you send a copy of that report down to the local newspaper office and, depending upon the kind of staff and the kind of attitude that they have toward such things, it might head directly for the waste basket; it might result in an editorial provided the editor has been bitten by too many mosquitoes in the last year, and has come to the conclusion that your are wasting the taxpayers' money. On the other hand, if you send out timely material—by this I mean information on something significant which is going to happen within the next week or ten days, it may alert a newspaper to cover some district activity. Material on something that has just happened, that happened yesterday or today is apt to capture their interest—but not something that happened a week ago.

I learned a great lesson when I was a student at Chico State. I was doing some publicity work about the "Homecoming Queen," a girl from Orland, so I had prepared a little news release that Carol Forbes had been crowned on the previous Saturday night. Now the Orland papers at that time were published on Tuesdays and Thursdays, so I figured that Monday morning would be plenty of time to get a news release over to the Orland weekly about this girl having been named kick-off queen. The story didn't run. The picture did with only a brief caption beneath it. But it came back to me with a cryptic note from one of the editors. It said, "My father was an old-time news man and he taught me something you too need to learn about newspapering. There is only one thing that smells worse than dead fish and that is old news." Since then I have always tried to get stories out in advance, particularly when they were going to Orland.

Another factor to be considered along with timeliness is human interest. This should be a "natural" for you people because of the fact that you are dealing with mosquitoes. I noticed the article in the *Santa Barbara News Press* giving a rather featurized coverage of some research material presented by your group on Monday. It seems to me that your activities lend themselves very well to human interest stories. Sometimes, however, you may find that you are being made the butt of a joke, rather than receiving serious coverage; however, my philosophy is that so long as your work is being publicized, as long as it is not derogatory, you probably are better off than you would be with a silent treatment. There is, I should think, a wide variety of subjects that a district might publicize. I will try to suggest a few of these first, and then mention some techniques that might be used in actually preparing releases on some of these topics.

It seems to me that every time you hire a new person in your district, you should put out a news release—a 3 or 4 paragraph release about the person, his background, what kind of job he will be doing for your district, where he comes from, his previous experience, etc. If you have some new equipment or are attempting to use new techniques in your district, or if you are initiating any kind of research activity, these are naturals for news stories. If you have new policies that are being enunciated by your board, this should be substance for a story. Another possibility is publiciz-

ing training sessions, or attendance at scientific conferences. It sems to me that every district should put out a release about attendance at a conference like this, with a few hard facts about what you are doing here besides having a good time. The natural taxpayer reactions to conventions is "Aha, he's off on a 3-day convention at my expense again." So in such a release be sure to mention certain highlights of the technical program and what the representatives of your program will be contributing to or obtaining from the meeting. Don't just say you went to a conference at the Miramar in Santa Barbara. Still another possibility is the annual report. Annual reports are very deadly documents for the most part, and a reporter given such a document and told to write a story on it probably will not be as inspired as perhaps you might me if you were writing a story on your own annual report. Instead of sending the document itself to the newspaper, you might better try to recast it into newspaper style and send out a release on it. Then if the newspaper gives it to a reporter for rewrite and he wants additional information he will call you up and ask you about it.

Actually, one of the advantages of using a news release is that you pretty well control what is going in. We have heard a lot about censorship of the news and control at the top of the news from Washington. What's wrong with a mosquito abatement district controlling the news? Actually, studies have shown that about 50% of the content of American newspapers today originates from handouts. It is a frightening thing for those of us in the academic world to realize that newspapers are abdicating their responsibilities to the point of being merely purveyors of handouts from all sorts of government agencies, private business firms, etc. The public relations man is king. Working newspaper men gripe about getting handouts all the time. They know that most of them are press agentry, or what we call "puffs,"—usually pats on the back for a particular organization. But many news rooms are understaffed and poorly staffed, and will not rewrite the material you send in, nor will they even make a phone call and ask you for more information. They will run it straight, provided it fits journalistic style. If it doesn't they probably won't even rewrite it; they will throw it in the waste basket. This is one reason why it behooves people in government who are interested in good public relations to master a few basic techniques that are involved in putting out a simple, one-page news release.

A few suggestions about the format of the news release would perhaps be in order. At the top of the page you should put the name of your agency, your mailing address, your phone number, and above all the person who either prepared the release or can give additional information; if a reporter decides to rewrite or add to the story he will know who to contact in your office. As for length of releases, if you can't say in 250 words whatever it is you are trying to put across through the newspaper, you are probably wasting your time. I should qualify this by saying that there are some newspapers that will print anything, and some will run interminable articles that go forever. In most communities newspaper space is really at a premium, so the important thing is to be brief. This usually means a 250-word maximum—an 8½″ × 11″ typewritten page, double spaced. It goes without saying that it is harder to put down what you want to say in a short space than it is in a long space. But in the case of a news release, I think definitely, the shorter the better.

As for the style of writing, there are a few basic things we can say about this. I believe the best way to learn about writing is to become a critical reader of your own newspaper. When you pick up the paper look at the way the reporter has written the story and you will notice a few of the following things about it. First, the opening senteince, or the "lead" in a news story, is usually no more than 25 words if written by a good reporter. You are all familiar with the basic "Who, What, When, Where, Why and How," which usually are wrapped up in the opening sentence of a news story. Also, news releases should be written in what is called an inverted pyramid style, or upside-down style, in which you say the most important things first and your paragraphs proceed—very short paragraphs—in descending order of importance. All you have to do to put it together is ask yourself, "If I can't say anything more than I have said in paragraphs one and two, then I'll put that material in paragraph three," and so on down the line. This is because in a newspaper office they allow what is known as a cut-off test. This is one reason why poorly written news pieces go into the waste basket. What is it you want the public to know? The answer should be in the very first paragraph and preferably within the first five words of your lead sentence. This is what is known as "hooking the reader." Incidentally, you have to hook the news editor first, because if he doesn't read past the first sentence of that release and the important thing that you are trying to get across is way down at the bottom of the page, you have lost him. Now the fact of the matter is that he may schedule that story to go into the paper tomorrow, but when it reaches the shop and is being put together, there just may not be room enough for all of the story. They have to cut part of it off and the experts in the print shop don't know how to cut stories—they know how to set type, that's all. Their instructions are to cut from the bottom, which means that they just take off the bottom two or three paragraphs or whatever is necessary to make that story fit whatever space is available. So, if your story is poorly written and you haven't followed the newspaper's style the chances of its being used are very slim, unless the newspaper is going to rewrite it entirely into its own style.

Frequent paragraphing is important. A paragraph in a news release should not contain more than two or three sentences. Forget everything your English teacher ever told you about paragraphing. One of the biggest troubles I have in teaching jouralism is that my students tend to get A's in my class and flunk English. This isn't saying that journalism is poor English, incidentally—it is not. It is a different English; it is a different style of writing. Short simple sentences are the rule—one subject in one sentence. Forget the connectives and start a new sentence each time you take up something new. This doesn't have to come out like a Dick and Jane reader either when you are finished, because your sentences can have variety of language along with simplicity.

If you have a photograph that helps tell your story, send it along; or indicate on the release that you have photographs available. If the newspaper sends out a staff photographer cooperate with him. His time is worth money to the newspaper and if he is sent out at 2:30 in the afternoon, don't make him wait around until 3:00. Have everything ready when he shows up. This way, he will come back next time. If you don't, the chances are that you will find the local newspaper telling you that they are interested in the photographs if you supply them, but that they won't send their photographers out.

This leads me to the final subject that I wanted to mention this morning—the techniques of getting along with newspaper personnel. They are an odd lot in many ways. They are a depressed people; they are grossly underpaid, are misanthropic and seem to hate the world by and large. They are very cynical and rather distrustful of people who work for the government. Eighty per cent of our newspapers are Republican as of the most recent elections, and they tend to be very watchful of the taxpayer's dollar. So, you may have sort of a barrier against you to start with, on the editorial side, that is. If we check the political registration of working newsmen we will find that most of them are Democrats.

The first thing to learn in getting through to your newspaper is whom to see in the office. You don't take in a news release about hiring Bessy Jones as a secretary and ask to see the executive editor of the newspaper. It may go to the society editor or the city desk may get it. You must learn how your particular newspaper operates.

Another tip is to learn when to go into a newspaper office. In most newspaper offices if you go in between 10:00 a.m. and 1:00 you are going to get the brush-off because those are the real rush hours for putting out a newspaper. 1:00 p.m. is usually press time and up until then the office is a beehive of activity. If you come in before 10:00 or between 1:00 and 2:00 your chances are better. Just find out what your paper's press time is, and determine who arrives early and who stays late. In many cases you don't have to go in at all. If you prepare a well written release it will probably be received just as well if you mail it in. Don't be pushy about your releases; don't send out a release and then get on the paper's back if they don't run it immediately. If you do, they will feel you are trying to do their job. They have to evaluate what news they have for the day and sometimes there just won't be space enough.

Never ask for a "kill." Never ask a newspaperman to withhold a story or information, short perhaps of your own neck—and even then they may not listen. They have their own standards, one of which is not to suppress news. It is a bunch of old wives' tales that newsmen kill stories about advertising men, etc. There is just enough of this sort of thing going on to give a little credence to it, but it does not happen too often.

Expect to have your releases rewritten and don't feel insulted if your beautiful work of art has been changed around somewhat. Just be glad that it gets in. And occasionally pat a reporter on the back. In many areas the work of your district may be very important, particularly agricultural areas, and there will be a farm reporter who will come around and see you quite regularly. If he writes a good story, let him know you appreciate it.

Finally, if you are in a competitive situation where there is more than one paper within your district don't play favorites. Send out releases to all and specify release time (e.g., 8:00 a.m., Monday) so that everyone gets an even break.

One last comment and that is that there are some aids available to you. A little paperback book, "Today's Journalism for Today's High Schools," by J. W. Agnew can be recommended. It is designed for high school students, and that is why I think it is excellent for the uninitiated. It tells exactly how the stories are put together—the five W's. It is put out by the L. W. Singer Company and costs $2.00. In a few pages it tells you how news stories are written and while it is true that they are all about the Hi-Y, etc., all you have to do is change the subject matter and put your releases together in the same way. Also, you might be fortunate enough to be near a campus where journalism courses are given. Most newspaper men would say that the worst possible way to learn about journalism is to take a course, and sometimes I have to agree with them, but if that avenue is open to you—evening schools or a university course—the investment of 30 hours or so may well be worth it in terms of public relations. Thank you.

HOW TO COMMUNICATE EFFECTIVELY WITH PICTURES

WILBUR I. HOFF
California State Department of Public Health
Bureau of Vector Control, Berkeley

At this time I should like to consider some techniques for achieving program objectives. These techniques are related to improving our communications.

Communication is important for two reasons. First of all, it is one of the most fundamental processes of human life. Secondly, it is one of the most valuable tools we have to create human understanding and ability. There is probably no other way to reach agreement on ideas and obtain action on programs than to get in good communication with people.

Since many of the difficulties we have with people in our health programs can be traced to poor communication, I want to examine some of the practical ways in which we can improve our communication with people in various aspects of mosquito abatement work.

To do this, I shall try to practice what I preach by keeping my talk brief and by showing you various pictures to get the points across. Some of these pictures I have created myself to portray ideas and concepts. Others have been created by some of you in your own mosquito abatement activities.

First, to talk about how to communicate more effectively, we must know what communication is. Let me begin by giving a simple definition of communication.

Communication is the interchange of ideas (or particles) from one person to another with the intention of bringing into being at the receipt point a duplication of that which emanated from the source point. Many people do not consider the importance of the duplication at the other end. This I believe, is the main purpose of communication—to get something over to the other person so that he knows, sees, understands exactly what is in the originator's mind at that moment. If the idea has been duplicated in the receiver's mind, the communication has been successful.

Let us concentrate on the element of duplication from this point. If we can achieve duplication in the mind of our receiver we will have gone a long way to accomplish effective communication. Many of our efforts at getting ideas across never fully reach this point of duplication and we never know just how effective we have been.

There are various ways to achieve duplication of ideas. The written and spoken word have just been discussed. But there is another very effective way to communicate which is often neglected. This is communication by images or pictures. These are commonly called visual aids. The main idea here is that pictures are usually exact copies of things. Let us take an example of how to duplicate an image with a camera.

Suppose that individual "A" wants to convey to individual "B" what an airplane looks like. He would go outside, take a picture of the plane, have it developed, and show it to "B." "B" would look at the picture and form a duplicate image in his mind. He does this because he sees a picture. "A" probably wouldn't have had to say any words to get the idea across to "B" of what an airplane looks like, and "A" would probably achieve almost perfect duplication of that picture in "B's" mind.

Now this is a bit oversimplified, of course. "A" probably could not have completed his communication by a picture alone. He might have to describe a few things about this plane if he wanted "B" to have a greater understanding of it, such as its flight characteristics, its cost, the use for which it was designed, and so forth. But can you imagine "A" trying to create a duplication of the idea by words only? Do you think the same degree of duplication could have been achieved? And how much more time would it have taken "A" to communicate by words alone? You are all familiar with the Chinese proverb, "One picture is worth a thousand words"; the Russians say, "He who has seen does not have to be told."

The University of Minnesota performed some tests about the effectiveness of oral communication. They found that on the average about 75% of the things we say escape the listener's mind. Therefore, with only about 25% being retained and understood it seems a waste of time to confine our communication just to words. This may be one reason why some people find it easier to remember people's faces rather than their names.

Much of man's thinking is done through imagination by creating visual images in the mind. Have you ever noticed how often you create visual images in your mind when you think about such things as what you intend to do for the day, who will assist you, and how it will be done? In many areas of thinking it seems much quicker and easier to think in terms of images or pictures. Similarly, in many areas of communication we can get our ideas across to others more quickly and easily if we do it by using visual aids of one sort or another.

Think how many of our professional and other working people communicate through pictures of one kind or another. Take for example engineers. Can you conceive how buildings or bridges would ever be built without the use of plans, drawings, or maps? Would you dream of having a contractor build you a house if all he had to go on was your verbal and written description of what it should be like? Physicians would not be very effective in diagnosing a case unless they had X-rays, encephalograms and other visual laboratory tests. And how would the mathematicians talk without their symbols, equations and graphs? You can undoubtedly think of many other instances like these where visual communication takes place.

When we see a picture of an object, we seem to get a greater reality about it—it means more to us and we understand it. This is the secret of using visual aids.

There are a number of different ways in which we can communicate by pictures.

1. *Drawings and diagrams.*—These can be quickly and easily made to get across an outline of a talk, how something works, etc. I am using this method just now with a flip chart to convey certain ideas to you.
2. *Photographs.* — This is another category with which you are all familiar.
3. *2 × 2 slides.*—Colored slides are fairly easy to take with a 35 mm camera.
4. *Films and filmstrips.*—There are a number of these available in health departments and other sources.
5. *Flannelgraphs.*

There are a few simple rules you can follow to communicate more effectively with pictures.

1. Decide *what* you wish to communicate about. Define the idea or concept. What is it—a control program, mosquito surveillance, your district staff, budget, etc.?
2. Determine to *whom* you will communicate. What are these people like? What do they think, feel and believe? Are they your own staff or board members, professional people, farmers, housewives, students?
3. *Where* will the communication take place? Will it be in a small room, a large room, an office, board room, auditorium?
4. *How* should the communication be accomplished? Get good, clear, up-to-date, well-composed pictures. Have equipment ready, including extension cords, spare bulbs, chalk, pens and paper.

Visual aids can be used in a variety of situations. If you think over your own activities and programs you will be able to find many opportunities to communicate through visual aids. Here is a brief list of situations where visual aids can be used effectively: (1) staff meetings; (2) board of trustees meetings; (3) orientation of visitors; (4) training sessions; (5) monthly operational reports; (6) annual reports; (7) newspaper publicity; (8) public relations activities; (9) community education programs.

To conclude, I want to make it clear that there is more to communication than showing pictures. Communication is a two-way process where a sharing of ideas and feelings takes place between two or more people. It is not merely a process of getting your point across to some individual. The other person has intentions too, and he may want to get across to you some of his own ideas and feelings. In this sharing process each person must be willing to listen to the other and explore his point of view. It is only in this way that points of agreement can be reached and a real level of mutual understanding can be achieved.

I hope I have been successful in communicating my ideas to you.

REPORTS FROM C.M.C.A. REGIONS

J. D. Willis, *Moderator*

SACRAMENTO VALLEY REPORT

Kenneth W. Whitesell
Regional Representative

The Sacramento Valley is composed of 10 counties with 14 districts, covering an area of 6,197 square miles.

The primary problems are rice fields, pastures, log ponds, and duck clubs. The problems in the southern portion of the Valley are largely rice, pastures, and duck clubs; the northern portion has less rice but more log ponds. I might add that the Colusa District has 21% of its total area in rice. Most of the Sacramento Valley problems stem from rice and an abundance of low-priced water which leads to over-irrigation and poor drainage.

Larvicidal work on rice and pastures is primarily accomplished by aircraft. The main insecticide is ethyl parathion applied at the rate of .1 lb. (one gallon) per acre. So far we have experienced only a small amount of resistance to ethyl parathion. When this has happened, methyl parathion has been substituted with good results. Thanks to the Bureau of Vector Control, State Department of Public Health, we now have a resistance laboratory in the Sutter-Yuba District's facility.

Aside from the general control programs, some of our districts have solved local problems with the kind of ingenuity which seems to characterize all mosquito control workers. The Los Molinos District has a problem with over-head sprinkling systems on unleveled pasture; to meet this problem they connect their power sprayer hose to the discharge side of the pump and inject the insecticide into the sprinkler system. The Shasta District has developed over a period of years a strain of *Gambusia* that is very tolerant of the highly acid log pond water. The Colusa District has built a very inexpensive but efficient weed burner out of what was a mist blower. If you wish further information on any of these items I can give you the names of the individuals who can furnish any desired details.

Our primary mosquitoes are *Anopheles freeborni* from the rice, sloughs, and river bottom areas; *Culex tarsalis* from rice—or any other water; *Aedes nigromaculis* and *A. melanimon* from pastures, road side ditches or any temporary flooding.

Some of the more tangible signs of progress among the districts of the Sacramento Valley include a new office and shop for the Shasta District; the Butte District is finalizing plans for a new office, shop, and vehicle and aircraft storage facilities; and the Colusa District is in the process of building a new shop, office, and vehicle storage building.

I might add that we welcomed a new district in Glenn County which goes by the name of Mosquito Abatement District No. 1.

NORTHERN SAN JOAQUIN VALLEY REPORT

Gordon F. Smith, *Manager*
East Side Mosquito Abatement District

The year 1962 saw the end of a three year period of drought in this region with enough water available for a normal irrigation season. Needless to say, the work load increased with the availability of water and a normal spray year was the rule.

Parathion and malathion were the insecticides of choice, with Baytex coming into use in curb and gutter spraying and, to a limited amount, in agricultural areas.

Limited resistance to parathion developed in the Turlock District and malathion resistance was noted in the Northern San Joaquin District.

The new Piper Pawnee (235 h.p.) airplane was made available in late spring. The East Side District took delivery on one of these aircraft in late June, the Turlock District in August, and the Merced County District in September. In the East Side District, where this plane was used for most of the season, it proved highly satisfactory. The pilot, Bob Porter, is very satisfied with its operation. Based on acres per hour sprayed, spray efficiency was increased 29% over the 150 h.p. Call-Air A-4.

The use of malathion dust to treat residual water or dairy drain water in pipe lines after the close of the irrigation season proved its efficiency through the winter of 1961-62 and has become a standard practice with the Turlock and East Side Districts.

For many years, the Merced District has had difficulty in carrying out an adequate program due to a low tax base and unwillingness of the County Board of Supervisors to allow a tax rate in excess of 15¢. This year the district formulated a policy of charging

for any aircraft spray work after the first application. Execution of this policy was unnecessary as the Board of Supervisors approved a budget calling for a tax rate of 18¢.

SOUTHERN SAN JOAQUIN VALLEY REPORT

RICHARD F. FROLLI
Regional Representative

The Southern San Joaquin Region comprises the five inland counties north of the Tehachapi Mountains: Madera, Fresno, Kings, Tulare, and Kern. It embodies the major cotton belt of California and also includes extensive duck club areas and vast acreages of irrigated pastures and alfalfa. Rice growing is confined mainly to west Fresno County.

The combined budgets of the districts in this area exceed $1,700,000, or about one-third of the total budgeted by all agencies in the state.

In 1962 the area enjoyed some relief from a three-year drought, with precipitation ranging from 7 to 10 inches. Runoff throughout the Central Valley was 100% of normal. The most notable effect of this wet year was the increased abundance of black gnats and tree hole mosquitoes.

BLACK GNATS.—*Leptoconops torrens* emerged during April and May in many of the districts. There were numerous service requests in Madera, Fresno, Tulare, and Kings counties. Two railroad workmen required hospitalization in Tulare County. Although no control was tried, a number of areas of infestation were recorded for the first time. Most of these areas were adjacent to unimproved native pastures with heavy soils. The Delta District encountered both *Leptoconops torrens* and *L. kerteszi.*

The reason for the abnormal incidence of *Leptocops* is unexplained, but some believe that the early rains caused the soils to crack, thereby releasing the matured adults; with the lack of late rains the soils were not resealed, thus allowing for the continuous emerging of adults.

The San Joaquin Valley districts are grateful to the San Mateo County District for the valuable biological information made available through their research.

MOSQUITO PREVALENCE.—A reappearance of *Aedes sierrensis* highlighted the early part of the season. This species had been inconspicuous for about 4 or 5 years in most of the districts. Infestations were rather severe in some areas, notably the fig garden area of Fresno County and the abandoned walnut orchards of the Delta District. Granular insecticides, applied by aircraft, were used in these situations.

Aedes vexans was controlled effectively with granular insecticides. There is some indication that this species is adapting itself to peach orchards in some areas. The success of this adaptation hinges upon whether certain new farming practices become widespread, namely, noncultivation of grasses in orchards and continuous irrigation up to harvest time.

This cultural practice is the current recommendation of farm advisors, who advocate the clipping of grasses as a substitute for cultivation since clipping requires less effort. Late irrigtaion tends to fill out the fruit at harvest time. A situation thus develops whereby ripe fruit, pickers, aircraft and insecticide are apt to arrive simultaneously.

Aedes melanimon was of little concern to most districts except Fresno Westside where it persisted through November due to the mild weather. It is one of the by-products of duck clubs.

Aedes nigromaculis, although the predominant preoccupation of most districts, was of little concern until the first week of September, when full scale control was temporarily lost. The population then fluctuated with electrical storms for a month, after which it gradually. disappeared.

Culex pipiens quinquefasciatus did not become a problem until very late in the season. Larval specimens were not picked up until May in some areas, about two months later than normal. On the west side of the valley it never became a problem, but further south it reached its highest density in several years.

Culex tarsalis, a dominant species in the rice areas this year, was not of major concern elsewhere.

Anopheles freeborni was of continuous concern in the rice areas of west Fresno County. The hibernating adults emerged in the winter months and larvae were abundant in the summer.

CONTROL.—Approximately 640,000 acres were treated in the Southern San Joaquin region during the past season. The trend is toward wider use of granular insecticides, particularly 2% ethyl parathion. This is applied in various ways from district to district. For hand broadcasting the horn seeder was used extensively. The Anderson broadcaster, used by the Madera and Fresno districts, was one of several types of power units used. This motor-driven hopper works like a barley broadcaster, attains a swath width of 60 feet and is mounted on jeeps equipped with hi-flotation tires for use on rough fields. Sand blasting guns, which shoot the granules or pellets, are used by the Madera, Coalinga-Huron, and Consolidated districts. The compressor is forward-mounted under the hood of the vehicle.

Granular applications from aircraft worked satisfactorily in rice fields with good circulation to facilitate dispersal. Aircraft applications were also successful in pastures in the Kern District. Volclay was used in both instances. Granular applications to river bottom areas along the Kings River met with little success. Parathion dusts were substituted thereafter.

AIRCRAFT.—There was a general increase in aerial application of insecticides. Three Piper Pawnee planes were purchased by Kings, Tulare, and Kern districts, bringing the total to 10 district-owned aircraft in the region.

INSECTICIDES.—The basic insecticides used in the southern San Joaquin Valley are the organophosphates: ethyl parathion, methyl parathion, and Baytex.

The granular materials are ethyl parathion 2%-6% Volclay, sandcore or HR granulars. Evidence of ethyl parathion resistance was found in Tulare and Kern districts. There were spotted misses with methyl parathion in Delta and Kings districts after two seasons.

None of the districts use DDT any longer, but many meetings of agricultural interests were attended during the season concerning problems of DDT drift.

SOUTHERN CALIFORNIA REPORT

NORMAN F. HAURET
Regional Representative

ANTELOPE VALLEY.—Control problems in the Antelope Valley were increased during the past year due to heavy rains and resulting runoff. Additional problems were encountered in alfalfa areas. In the past, control of yellow aphids had indirectly controlled mosquitoes. However, with the development of resistant strains of alfalfa, aphid control is no longer required, consequently additional mosquito control measures by the district were necessary.

The efforts of the district, as in the past, are primarily directed toward source reduction, with a spray program assuming a secondary position.

A new building is being planned and will be completed this year. This will increase the operational efficiency of the district.

BALLONA CREEK.—This district is rapidly becoming urbanized, with residents demanding a high degree of control. Midge problems are becoming more numerous. One canal, used for swimming, caused such a problem last summer that it became necessary to treat it with malathion granules. The city health department cooperated in the venture by patrolling the canal to keep swimmers out.

The Playa del Rey swamp area has been converted into a beautiful marina.

The district installed two 2,500-gallon underground storage tanks for diesel oil.

BORREGO VALLEY.—A long-handled device was developed to introduce mosquito fish into standpipes. Although no larval counts were made, the light traps showed lower adult counts.

The Borrego *Hippelates* trap was received favorably by the citizens within the district and by entomologists. While an attempt to patent the device failed, the district retained its right to make and use the device free from interference.

The district is attempting to develop a device, using DDVP and ovum putrescents (rotten eggs—Ed.) to reduce gnat populations at point of origin. Preliminary experimentation indicates it may have value. The device resembles a "Molotov cocktail" and consists of a beer can half filled with DDVP and ovum putrescents into which a flannel wick is inserted. The gnats are attracted to the wick and killed.

COMPTON CREEK.—The district annexed 4.1 square miles of the City of Compton. The entire city is now in the district.

A Jeep with a bulldozer blade was purchased to be used in clearing the bottom of waterways.

The district now has its own building which serves as an office and headquarters.

GOLETA VALLEY.—The district annexed 1.5 square miles.

A new manager, Thomas B. Cone, replaced David K. Boraker in September 1962.

The district has changed its granular insecticide from malathion to Baytex.

A transition in emphasis from natural and agricultural sources to domestic sources is gradually taking place.

NORTHWEST.—After three years of organized mosquito control in this area, the results of the district's program are gratifying. Back yard sources are still a problem. The some 12 to 13 miles of Santa Ana River bottom area also is a major problem requiring intensified effort.

SOUTHEAST.—The district annexed three additional areas: the Friendly Hills area with approximately 10 square miles; the Dominguez-Keystone area of about 20 square miles (annexed under the provisions involving noncontiguous territory); and the City of Gardena. The assessed valuation of these annexations is about $180,000,000. These annexations required an increase of 3 temporary men and the addition of one Jeep Dispatcher.

The district has almost completed a change-over from gear-driven pumps to air compressors driven off the vehicles' engines. There has also been a change to right-hand driven vehicles. This has enabled the district to carry on its spray program with one man per vehicle.

Baytex emulsions and granules were used in the control program during 1962. Complete control was obtained for 16 to 18 days with an application of 0.1 lb. per acre.

The district negotiated a contract with the Los Angeles County Flood Control District to handle control of chironomids in the water spreading basins and flood control channels in the Whittier Narrows area. The contract includes the cost of medical supervision involved in the use of parathion.

The district now has a full-time entomologist, Douglas C. White.

ORANGE COUNTY.—During the past year the district confirmed the design of new equipment and the selection of granule larvicides. The new vehicle equipment, which proved completely satisfactory, includes a Jeep Dispatcher with right-hand drive and automatic transmission. Spray equipment now includes: (1) an automatic air compressor with a combination supply tank for compressed air and liquid larvicide; and (2) compressed air granule gun.

The granular larvicides now used include 1% Baytex for street gutters and 2% parathion for flood channels.

PRESIDENTIAL MESSAGE

DAVID E. REED, *President*
California Mosquito Control Association

I was especially thankful for Mr. Veblin's excellent talk during the first session because my so-called "presidential message" is actually more like a press release than an address—a little better than one page of notes, double spaced.

There is probably little that can be said about our Association that has not already been eloquently expressed by past presidents and others. We could perhaps say more about the objectives and purpose of the Association, or the responsibilities and privileges of membership. On the other hand, if we didn't believe in the Association we would not be meeting here these past three days to review our progress, to discuss our problems, and to lay our plans for the future.

As the years go by we cannot help but be aware of the subtle changes that are taking place within our organization. As we review in retrospect the major issues which have been brought forth during the past years—and some of these issues have been quite controversial—we can profit by carefully and objectively evaulating the wisdom of past actions and decisions in the light of changing times. Similarly, in meeting the problems facing us now and in the future we must ask ourselves if our proposals are sound enough to stand the test of time.

It is my hope that during the coming year our Association will be characterized by freedom of expression and mutual trust. We should welcome the skeptics as well as the idealists, and the conservatives along with the adventurers. Under no circumstances should we ostracize those who disagee with our individual views. We must be prepared for healthy differences of opinion, for it is the successful debate to justify our collective position on various issues that will make our Association mature. Further, if our principles and our practices cannot stand up in the face of penetrating scrutiny and constructive criticism, they have not earned the right to prevail or to be practiced.

During the immediate years ahead the Association has a tremendous challenge and, in fact, an inescapable responsibility to participate in a comprehensive program of vector control research which will provide the framework for a sound, progressive, integrated technology. During the past year the foundation was laid for a cooperative and collaborative approach to vector control research between the University of California and the California State Department of Public Health. General areas of responsibility in vector research were defined and agreed upon in principle by these organizations. It is our responsibility, then, as workers in mosquito and vector control to make these research agencies and institutions aware of our specific problems and research needs. Naturally, the people we in vector control serve will be the direct beneficiaries of the accomplishments of this research.

It is my sincere hope that during the coming year substantial progress will be made in expanding and accelerating this coordinated mosquito and vector research program and that the Association will play an active role in this cooperative effort.

It has been a pleasure and a privilege to participate in the activities of the Association during these past several years. The professional experiences and personal associations have been invaluable to me. It is therefore with a mixture of humility and gratitude that I now accept this opportunity to serve you in this somewhat awesome position of leadership during the coming year. Thank you.

Mr. Willis: Thank you, Dave. I am sure that all of the members of the Association will help you in every way possible and we wish you every success during the coming year.

I would like to thank the Program and Local Arrangements Committees and all of the other individuals who were responsible for making this meeting so successful. I now declare the 31st Annual Conference of the California Mosquito Control Association adjourned.